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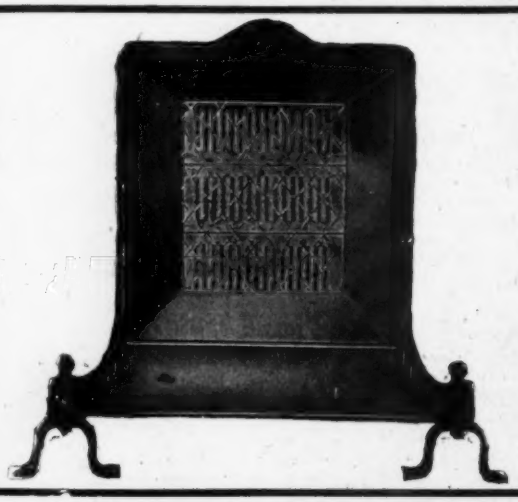

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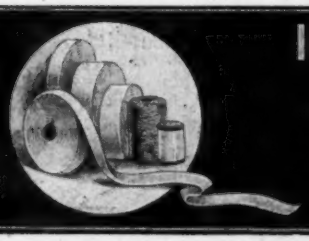

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ELECTRICAL REVIEW.

VOL. LXXXIX. DECEMBER 30, 1921. No. 2,301.

ELECTRICAL REVIEW.

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BRITISH WATER POWER.

THE final report of the Water Power Resources Committee, which was outlined in our last issue, does not depart greatly from the substance of the four interim reports, but it brings together a mass of information and comment which will render it of great value as a work of reference. The subject is immensely complicated in this country by the demands of our cities and towns for water supply, and for this reason the Committee strongly recommends the establishment of a central controlling body in the shape of a Water Commission for England and Wales; in Scotland the conditions are so far different, owing to the sparse population and the abundance of water, that such a body is considered unnecessary. Water commissions for 60 years past have recommended the establishment of controlling authorities, and the present Committee's conclusions were almost unanimous.

The functions of the authority would include the collection of information regarding our water-power resources and placing it at the disposal of undertakers, enabling them to select suitable sites for development, assistance in the prosecution of such schemes and in obtaining statutory powers, safeguarding the interests of the local population, and the collection of statistics of rainfall and flow over long periods, a service which can only be rendered by the State. A system of standardised data is put forward in the report, based upon the highly elaborated methods of the Canadian authorities, and it is proposed that maps and indexes of water resources for the whole of the Kingdom shall be available at a central office. In view of the assistance that the Commission would be able to render to water supply undertakings, the Committee thinks that a large share of the expenses of the Commission should be borne by them, thus reducing the cost to the ratepayer; but we fear this argument will not go far to mollify the intense opposition of the public to the establishment of a new authority at this time, when the severest retrenchment is the order of the day. Whether the cost is thus distributed, or is borne by the Treasury, the result is the same—the citizen has to dip into his pocket a little deeper—and whilst we admit the advantages of the proposal, we are bound to regard it from the standpoint of financial expediency.

On the other hand, with regard to water power in particular, the Committee would entrust either the Board of Trade or the Electricity Commissioners with the duty of supervising and promoting the development of the resources of Great Britain, and to this proposal we offer no objection. It is undoubtedly most desirable that this important question should be taken in hand as soon as possible, and if it can be dealt with by an existing Government department, the additional expense will be a minimum.

It is to be hoped that if and when Government action is taken, it will be taken with the express object of development. We have seen how, in the United States and Scandinavia, where water power is available in abundance, Government control has resulted in deplorable delays; with a view to securing the best terms for the State, impossible conditions have been prescribed. If the aims of the Committee are to be fulfilled, it is absolutely essential that private enterprise shall be given a free hand and an extended tenure—otherwise our last state will be worse than the first.

With regard to tidal power, it is felt that a *prima facie* case has been made out for its further investigation; the Severn scheme is admitted to be technically

feasible, and if it is proved to be commercially impracticable no other project of the kind has any chance of success. Attention should be given therefore, says the Report, to the possibilities of the Severn scheme in the first instance, and the experiments set on foot by the French Government, as well as Italian proposals, may be cited in support of this recommendation.

INDUSTRIAL AFFAIRS.

"The leading strings, which preserve and uphold the infant, would impede the full-grown man. And so the very means by which the human mind is, in one stage of its progress, supported and propelled, may, in another stage, be mere hindrances."

When Macaulay wrote thus about the coming of the Reformation, trade unions were in their very early stages. The time has come to-day, however, when it is the duty of all who have the interests of the workers at heart, among whom the leaders and members of trade unions should be prominent, to take stock of the situation, to examine the machinery, and, in general, to ascertain whether the organisations as they exist are suited to the circumstances of the present time.

In the days when workers were ground down, when child labour was largely employed, when women worked under horrible conditions at unsuitable occupations, the combination of workers to improve their lot was just, necessary, and desirable. There were those who thought the abolition of child labour would spell the ruin of industry but they were mistaken. The improvement of the lot of the workers for which trade unionism has been mainly responsible has not only done no harm, but has done positive good, to industry. In like manner the leading strings of the infant, and the dogmatism of Rome, were necessary to the immature body of the child and the immature mind of mediæval humanity. They did good, and without them much could not have been done that was done.

Humanity, when mature, is impatient of restrictions. Trade unionists object to the limitation or obliteration of initiative following upon the widespread adoption of process specifications based upon motion study and so-called scientific management. To a great extent we are in sympathy with them, for a man or woman is not a machine, and ought not to be looked upon as one. Yet how far do trade unions leave the individuals who compose them any freedom of thought? A small group of extremists may seize the direction of a union, or of a branch, and may behave in a way absolutely opposed to the wishes of the majority of its members. We need not go outside London for an example of such a happening. It is not many weeks since the executive of the E.T.U. suspended the London District Committee on account of its extreme and unruly behaviour, examples of which will be within the memory of our readers.

Anything in the nature of tyranny will, in the long run, inevitably be resented, and that resentment will more readily come to light in bad times than in good. When, as was the case during the war and the post-armistice boom period, wages are increasing and employment is good, dissatisfaction is apt to fizzle out in a few scarcely-heard grumbles. But when men are standing about waiting for doles, when the wages of those who remain at work are falling, that dissatisfaction will be expressed both in a more audible and in a more practical fashion. The A.E.U. lost 10,000 members during the single month of October, 1921. Mr. Thomas spoke pessimistically a few weeks ago about the N.U.R. In some degree, and perhaps a substantial degree, the decrease in membership may be due to the slump in trade, the fall in wages, the general unemployment, in short, to the industrial situation at large; but it is impossible to ascribe to these causes, or to any of them, the widespread apathy that was revealed in, for instance, the engineering wages ballot. Here was a case in which the question to be voted upon touched every member in the pocket. Would they, or would they not, strike to retain what they had gained? Yet a large proportion of the membership would not take the trouble to answer the question, and thereby tacitly declined to strike. Some of this apathy may have been due to a realisation of the futility of a strike at a time when most employers, or at least the smaller ones, as we commented at the time, would have been rather glad to shut down their works; but on many occasions, where the clear-sighted saw at the beginning that futility which the failure of the strike proved, the fact was not allowed to prevent the strike from taking place. But we believe that in general the man on the floor of the shop was, and is, tired to death of being driven, or led, or coerced into striking every little while, and losing several weeks' pay, about an issue which might concern him only remotely.

The time has gone by when a central executive can appreciate conditions all over the country, and can co-ordinate reports, and direct uniform action as a result of its information. Devolution is necessary. The workers must combine, just as employers must combine; and employers and workers must combine together. By the establishment of works committees (upon which the representatives of the workers ought to be trade unionists), to which the employers could furnish information as to the present state and future prospects of business, and by which the best methods for the advancement of the firm, and of the industry, could be discussed, much good would be done. The advancement of the nation's industries is the advancement of the nation. But employers and employed cannot get down to facts at a meeting hundreds of miles away from those facts. They must talk matters over and fight them out on the spot, at the works where the things that have to be discussed actually happen. Then they will be able to see what is the best course to pursue; whether, for instance, the adoption of the now famous and very successful Priestman scheme of profit-sharing can be beneficially adopted, or whether hours have to be extended in order to reduce costs of production. Men will interest themselves actively in matters which they can influence, and when they can see with their own eyes, in their own shops, the results of their activities. And if, as would be proper, membership of his trade union could be taken as a sign of a man's competence in his trade, then the unions themselves would benefit by the devolution of their responsibilities, and consequently the beneficial activities of the unions could be considerably extended.

Moreover, the existence of a works committee would come, in time, to be recognised as a symbol that the management was reasonable and progressive. The conservative, secretive, difficult kind of employer would find his business suffer, because the best workmen would prefer to work for his rivals. He would therefore find it imperatively necessary to advance with the times. Is it not abundantly clear that pressure of that sort would be better and more effective than the kind of general strike we have seen of late years? Why should a good employer be hampered and his workpeople impoverished because of the necessity of bringing a bad employer to his senses? He will be protected by the other employers, whereas if there were no question of his men downing tools as a body, but only going, individually, to a more agreeable concern, he would suffer alone, and would have to take the only means of improving matters, unless he were so stiff-necked as to prefer to go out of business.

There is still room for individuality. The strength of the British commonwealth of nations, as it seems we are now to call it, lies in the individual strength of the several nations composing it. Centralisation of Imperial affairs has been proved to be impracticable, and has been given up. Centralisation in industrial affairs, though not yet given up, is no less impracticable, and it will have to make way for methods more adapted to the needs of the times in which we live.

The Secrecy of the Ballot in Trade Disputes.

On several occasions during the last few years the public, who have been the innocent victims of disputes between Capital and Labour, have been astonished to find that a settlement has been arrived at within a very short time after the rejection of very similar terms "by an overwhelming majority of the men!" One reason for this apparent anomaly may be that the method of taking the opinion of the men is faulty in some material respect. Either the men have not understood the proposed terms or they have been prevented from expressing their real opinions by the fear of disclosure. A recent case before Mr. Justice Sargant makes it plain that where the rules of a trade union provide that a vote shall be recorded in a particular way—a way designed to ensure that the secrecy of the ballot shall be preserved—and that rule is not observed, the ballot is vitiated and cannot, in the result, be enforced.

It appears that on May 30th, 1921, a ballot was taken of the members of the National Society of Operative Printers as to a proposed alteration of the rules. The ballot papers of about half the members were marked with the numbers of the men to whom they were issued so that these men could be identified. It was not suggested that the marking was done with any sinister object, but in the view of the learned Judge "the secrecy of the ballot was very considerably stultified." Having expressed the opinion that under the rules "ballot" involved a method of secret voting, he held that the resolutions which followed the ballot were not binding. Seeing that the rules which Mr. Justice Sargant had to consider are in all essentials common to a large number of trade unions, it is obvious that his decision is of considerable importance, and those who are responsible for the proper administration of the unions will do well to remember the decision at which he has arrived. They should follow a little more closely the procedure by which those who enjoy the franchise are able to record their votes at elections. Whatever else has been said against the system by which members of Parliament are elected, no one has ever impugned the secrecy of the ballot. We are convinced that a very large number of trade disputes could be avoided, or composed at a much earlier date, if every member were satisfied that he could record his vote on the matter without fear or favour.

The Art of Salesmanship.

The popularity of the E.D.A. salesmanship conferences is evidenced by the large attendance at the second meeting, held on Friday, December 16th. A great deal of enthusiasm was displayed by those present to join in the discussion, which dealt with the selling of electrical power-driven appliances in the home, but it would appear, from the remarks made, that this enthusiasm is not always reflected in the actual selling of the apparatus. As was pointed out, it is a great asset for a salesman to be able to tell a prospective customer that he is successfully using in his own home the particular appliance he is trying to sell. Here, however, we had the spectacle of an electrical contractor discussing ways and means of increasing his sales of electrical appliances, whilst himself admitting that he had discontinued the use of such an appliance in his own home because it made a noise. The same sort of thing has happened before with regard to electric cooking apparatus. This is surely not conducive to good business, and the point was pounced upon by subsequent speakers.

In discussions on salesmanship we have acquired the habit of looking for some information with regard to American methods, and we generally get it; on this occasion, too, we were not disappointed. Although electrical appliances are much more popular in America than here, the Americans have one advantage, and that is that there is a larger percentage of houses receiving a supply of electricity. At the same time, it was interesting to hear that owners of apartment houses there sometimes install electrical washing machines before tenants move in, but there is reason to believe that the price of the apparatus is a big factor in this connection. An American speaker, in order to indicate new fields for the sale of washing machines, instanced the case of an American woman who installed one on the hire-purchase system and developed a clothes-washing business, which was sufficiently profitable to provide her with a motor-car. In this country, of course, there is a great deal in the fact that, comparatively, so few houses are connected with electricity mains, and but for the fact that the discussions are confined to selling methods, there is no doubt that much would have been said about the methods of supply authorities. It is of interest to note that whilst the big stores were decried on the last occasion on account of their "jerry" wiring, on this occasion the suggestion that they should help in popularising the apparatus met with a good deal of approval. A point much discussed was the necessity for the salesman to gain a thorough knowledge, not only of the appliances he is selling, but of their application, and Mr. Morton's remarks on the details of clothes-washing certainly point to the fact that he practises what he preaches.

Railway Electrification.

The paper read by Sir Vincent L. Raven, K.B.E., before the North-East Coast Institution of Engineers and Shipbuilders, of which an abstract is commenced elsewhere in this issue, is noteworthy on the following grounds, amongst others—namely, that it emanates from a leading steam railway engineer; and that it makes out an absolutely convincing case for the adoption of electric traction on railways. We cannot recollect any previous paper which so fully compares not only the relative merits of steam and electric locomotives, but also the extremely important accessory plant and equipment and the operating methods which are inherent respectively to the two systems of traction, and whilst we are unable to reproduce the long paper *in extenso*, we feel that it calls for an exceptionally full abstract.

From time to time revolutionary changes take place—not without difficulty and in the face of strenuous opposition—in thought and practice in various walks of life; such changes, for instance, as the substitution of iron for wood in shipbuilding, of steam for wind power in ship propulsion, and of turbines for reciprocating engines in numerous applications; such a change is in progress before our eyes in the methods of traction on railways, and it is exceedingly interesting to watch its development. Quite naturally and properly, engineers who have at command the vast experience that has been gained with steam have regarded the upstart electric locomotive with suspicion, and have been keenly critical of its possibilities and alleged advantages; as ever, "the old is good." But it is an essential characteristic of every engineer worthy of the name that he is open to the reception of new ideas and is willing to adopt new methods, when he is satisfied that the new are better than the old. How else could the turbine—the "steam-eater" of 1890—have established itself on board ship?

We see the same process at work on land, and we welcome the accession of so eminent an authority as Sir Vincent Raven to the ranks of the convinced supporters of electric traction. A fact which adds to the weight of his advocacy is that for many years the railway of which he is the chief mechanical engineer has carried on both passenger and goods haulage by electricity on a scale which has enabled him to judge at first hand between the merits of electricity and steam: he speaks of that which he doth know. Moreover, the North-Eastern Railway Co. is about to electrify 250 miles of its main-line system. Granted that the advantages of railway electrification are now generally admitted, the fact remains that up to the present practically all our development in that direction has been associated with suburban railways; in this paper, heavy goods and passenger transportation are dealt with, and it is bound to aid materially the adoption of the larger schemes.

BREAKDOWN TESTS ON INSULATING MATERIALS.

A Simple "Guard-Ring" Method.

By N. A. ALLEN, B.Sc.

The commercial method of testing samples of materials used for insulating purposes consists, in general, of placing a layer of the substance to be tested between two flat circular brass plates having rounded edges and applying a voltage until the dielectric breaks down. The size of the sample is chosen so that sufficient overlap is obtained to obviate flash-over around the edge of the specimen from one plate to the other.

It is noticed that the material almost invariably fails near the edge rather than at the centre of the plates. This is due to the increased electrical stress at the edge of the plate, illustrated in fig. 1, causing

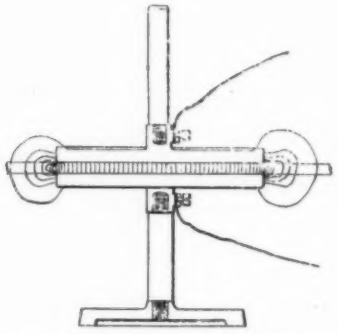


Fig. 1.—Lines of Stress: Parallel Plates.

breakdown there at a lower pressure than the voltage at which the failure would occur if the dielectric were stressed uniformly.

The use of some form of guard-ring for tests of this nature is well known. If the guard-ring is badly arranged, however, the specimen will be found to fail at the edge of this ring instead of at the edge of the plate.

The method described below has been developed by the author, and has given complete satisfaction. The diagram in fig. 2 shows a section of the apparatus, which consists of a smooth base of cast iron supported on ebonite pillars. The sample to be tested is placed flat on this base, and a smooth circular brass plate placed upon it. The guard-ring, which is a heavy cast-iron ring, is laid down concentric with regard to the plate,

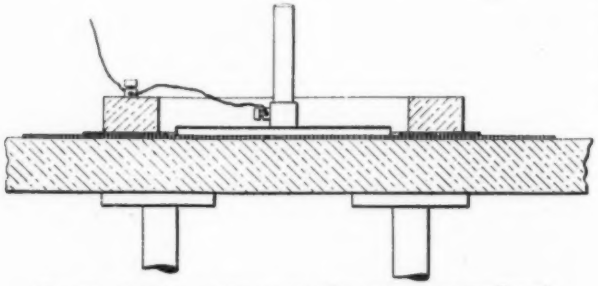


Fig. 2.—Section of Apparatus (Dielectric not to Scale).

but instead of resting upon the sample it is placed upon an annular ring of the insulating material, identical in all respects with the specimen under test, and projecting by $\frac{1}{8}$ in. on all sides of the guard-ring.

The insulator ring itself rests upon the specimen, and is pressed tightly down by the weight of the cast-iron guard-ring, excluding air-spaces as far as possible. The distance between the inner edge of the guard-ring and the outer edge of the plate is approximately $\frac{1}{4}$ in., the diameter of the plate 3 in., thickness $\frac{1}{8}$ in., while the inner diameter, outer diameter, and depth of the cast-iron ring are $3\frac{1}{2}$ in., 5 in., and $\frac{1}{2}$ in. respectively.

At this point it may be mentioned that too much stress cannot be laid upon the necessity of eliminating air-spaces when conducting tests of this description. It was pointed out by Steinmetz that the introduction of a layer of insulating material of high dielectric constant (specific inductive capacity) into an air-gap which is in a state of electric stress approaching breakdown, is liable to cause a brush discharge across the gap. This is because the voltage drops on two condensers in series (*i.e.*, in this case a layer of insulator and an air-gap) having equal charges and dimensions, are inversely proportional to their dielectric constants. Thus the air takes more than its share of the voltage, the air is stressed at a higher value, and breakdown occurs. This phenomenon, which has only in recent times been admitted to its proper position of importance in the mind of the electrical engineer, has been the cause of many failures of insulators which are working at safe nominal stresses, whereas owing to the presence of air-pockets the actual stress is sufficient to cause a brush discharge across the air-gaps, with carbonisation and consequent breakdown of the insulation.

In fig. 3 is indicated the state of stress distribution in this apparatus. The presence of the outer conductor at the same potential as the testing plate causes the lines of force to be parallel not only in the centre, but also at the edges of the plate, while the insulating ring prevents breakdown at the edge of the guard-ring.

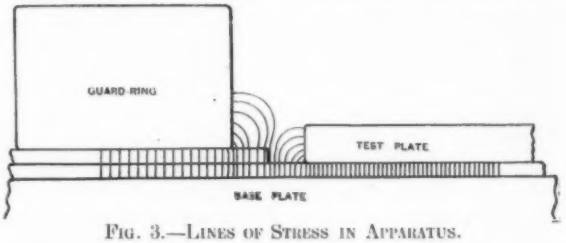


Fig. 3.—Lines of Stress in Apparatus.

Thus a fair test of the dielectric strength of the material is ensured.

A series of tests was carried out with some $2\frac{1}{2}$-mil insulating paper, first without any guard-ring, secondly with the apparatus which has been described, and a table of comparative results is given, indicating the number of failures occurring at the edge and at the centre of the plate in the two methods, and also the respective breakdown voltages.

	I	II
Number of tests	53	85
Number of failures at edge ...	45	2
Percentage	82%	2½%
Number of failures at centre ...	8	83
Percentage	18%	97½%
Average breakdown voltage ...	1080	1190
Percentage	91%	100%

I.—Plate without guard-ring.
II.—Plate with guard-ring.

The advantage of this method is that it is just as convenient as the ordinary commercial method: the same annular ring of insulator can be used for a large number of tests, and the results obtained are more accurate with this than with the other method, providing a fairer test of the behaviour of the material under uniform electric stress.

THE FOUNDRY ELECTRIC FURNACE.

By JAMES EDGAR.

The industrial uses of electric furnaces are very numerous, and one of the most satisfactory developments has been their invasion of the foundry. This department has long had the reputation of being extremely conservative, but innovations are accepted there as they are elsewhere—with a good deal of suspicion. The number of electric furnaces in operation is small in comparison with the number of foundries. There are over 3,000 foundries in this country, and the great majority of them carry on with combustion furnaces.

The cupola requires a great deal of attention and considerable skill on the part of the men in charge to ensure satisfactory results. It has, however, important qualifications. Its efficiency is relatively high; it would appear to be about 40 per cent., and it is comparatively cheap; for instance, from 2 to 5 cwt. of coke will melt a ton of metal. It cannot, however, be called simple in operation, and the melting is done, as with all combustion furnaces, in the oxidising influence of the blast, which is harmful to some of the elements, notably manganese and silicon.

Notwithstanding the failings of the cupola, however, foundrymen are decidedly partial to it, and it is, as a combustion furnace, a good type. It is very improbable, indeed, that the electric furnace will oust it from the iron foundry, at any rate for a considerable time, although, if electrical engineers really concentrate on foundry requirements and electrical energy becomes cheaper, the number of electric furnace installations will grow rapidly. With steel, iron and brass alike there are two great points in favour of the electric furnace, the first being that the melting is done in a reducing atmosphere, and there is thus no oxidisation, while the second is that a high degree of superheating is necessary to ensure good castings, whereas the superheating power of combustion furnaces is limited.

Messrs. T. Summerson & Sons, Ltd., one of the few British iron-founders who use an electric furnace for melting iron, had some fine castings on view at the recent Shipping and Machinery Exhibition at Olympia. This firm found, on a microscopic examination, that in the best iron there were patches of sulphide and phosphide, and also that the carbon stood out in lumps, while the grain was loose. By electrically melting the iron, they have eliminated phosphides and sulphides, and produced even, close-grained metal.

What is called the duplexing process will eventually be practised in many iron foundries; that is, the iron will first be melted in the cupola, and then transferred to the electric furnace to be superheated.

In the steel foundry the electric process has become popular. For the benefit of those who have not studied steel foundry practice, it may be said that there are at present four processes: the open hearth, the Bessemer or converter, the crucible, and the electric processes. Until the electric furnace was introduced, crucible steel was used for castings of the highest grade, and opinion was divided between the open hearth and Bessemer processes for general work. Now, electric steel has largely displaced crucible steel, and many castings that were formerly made by the Siemens furnace or converter, are now made of electrically-melted steel. The metal, for one thing, is much purer. A great recommendation for the electric furnace to steel foundrymen consists in its refining properties. It is frequently only used for refining. Sulphur and phosphorus, which are very objectionable elements, can be almost entirely eliminated owing to the intense heat, and almost any class of steel can be produced from the cheapest material. Another point sometimes cited in its favour is that little brickwork is necessary. In the future, electric furnaces of much larger capacity will have to be made to cope with all classes of work. It is in the steel foundry that they have made the greatest progress. Castings are more costly because, in addition to the cost of electrical energy, the upkeep of the furnace lining is heavy owing to the high temperatures. With large furnaces, upkeep charges would be proportionately lower.

It has been found that it is more economical to keep an electric steel furnace going all the time than to allow it to cool after each heat, because it is less destructive of the furnace lining. Some firms have found that they could make the furnace pay by having two heats a day, but have been handicapped by the workmen refusing to work the necessary hours. The consumption of electrodes is also an expensive item.

Electric furnaces should make rapid headway in brass foundries; much more rapid indeed than in the iron foundry. At the present time there are several excellent non-ferrous electric furnaces on the market. In one of these, the Morgan Crucible Co.'s furnace, the crucible is made of special conducting material, and has extension rings at top and bottom to carry the terminals. The lining of the crucible is composed of an insulating material. Water-cooled gunmetal terminals are used to convey the current into the walls of the crucible. At the Shipping and Machinery Exhibition the "Leifur" furnaces of the Leeds Electrical Construction Co. proved of great interest to foundrymen.

The melting of brass in the electric furnace presented peculiar difficulties. One objection to the arc furnace is that, with so high a temperature, the zinc was volatilised. Flexibility is an essential qualification for a brass foundry, because of the variety of mixtures to be melted. More types of furnaces have been evolved for brass melting than for iron and steel, and there has been more disagreement among foundrymen as to which is best.

WATER-POWER TROUBLES.

By E. SCOTT RIVETT.

In many newly-settled countries rainfall and stream-flow records are still in a very incomplete state, and the designer of a hydro-electric plant is hard put to it to find reliable data for the basis of an estimate of the power available at some particular fall during all the months of the year. In such a case it is not advisable to place much reliance upon the memory of the oldest inhabitant, and, besides, there may be no oldest inhabitant.

The extreme value of precise records extending over a period of years is, of course, generally recognised by hydro-electric engineers. It is therefore easy to understand that, occasionally, owing to incomplete records or a too sanguine temperament, serious mistakes are made, but the following case of the Minnedosa (Canada) plant seems almost incomprehensible.

Some years ago a local company was formed to harness a waterfall near Minnedosa on the Little Saskatchewan river, and a hydro-electric plant was installed. An earth-embankment dam about three-quarters of a mile in length was built, giving extensive water storage and the development of a head of 25 ft. A six-foot penstock led to the power-house, where a horizontal-shaft turbine was connected to a 375-kVA generator. The drainage area had not been thoroughly studied, and when the plant was put into operation and service started, the company faced the fact that during the winter months no water flowed into the reservoir, so that plant operation was possible only from eight to nine months in the year, and during the season of greatest need—the winter months—there was no delivery of power. The company spent a large sum of money in the endeavour to remedy this condition, but finally was obliged to cease operations and go into liquidation. The plant has now been taken over by the Manitoba Power Commission, and it is proposed to re-design the whole hydro-electric outfit. In the meantime two 120-b.p. semi-Diesel units have been installed, and are working satisfactorily at an average fuel oil consumption of 0.9 lb. per kWh.

In the above instance, the designers of the plant overlooked the complete cessation of winter flow. The case of Wallace, Idaho (U.S.A.), is on a different footing. Here power is developed from water collected in a catchment area of about 2,000 acres, formerly well timbered with trees from 50 to 200 years old. In 1910 the watershed was entirely burnt over. Before the fire the stream flow was never below 1,000 miner's inches, but since then it has fallen to a fourth of that quantity, and the company supplying water, light, and power in the district, has been compelled to spend considerable sums of money annually in developing power from steam and using part of it in pumping water. Records of the weather bureau at Wallace show that the precipitation has been about normal, and one is thus forced to the conclusion that the unevenness of flow is due to the destruction of the timber and not to any change of climate or rainfall.

It is not often possible to increase the average stream flow of a river, but an attempt to do this is now proposed in Northern Ontario. The growing gold-camp in the South Porcupine district has suffered from a shortage of power for some winters past, and the company supplying electricity to the mines has now developed every available foot-pound on the Mattagami river. The demand is still increasing, and the present supply will be inadequate during the next period of low water. To overcome the difficulty, it is proposed to divert the water of the Grassy river, which now discharges into the Mattagami some miles below the chief power-house. At the place where it is intended to join the two rivers they are fifteen miles apart, but by a system of dams engineers have discovered that the water can be backed up through a chain of small lakes and rivers, so that only about 300 ft. of channel cutting will be necessary. The project would change the complexion of an extensive area, and alter the lower reaches of the Grassy river from a formidable river to a trickling stream, but it would make gold production and employment at Porcupine more certain.

FOREIGN LANGUAGES AND ENGINEERING DEVELOPMENT.

By ALEC. B. EASON, A.M.Inst.C.E., A.M.I.E.E.

At a recent meeting of electrical engineers mention was made of the great development of water-power for electricity and the widespread use of electricity in small towns and village on the Continent, as compared with what one finds in this country. Two natural factors partly account for this development: first, the average density of population is much less than in England, and this reduces the difficulties of running transmission lines, as it is easier to run them in uninhabited areas than in towns; secondly, there are much greater resources of water-power on the Continent than in this country. But the educational factor has something to do with the development; the proportion of engineers on the Continent who know two foreign languages is greater than the proportion of English engineers knowing two foreign languages. Many Continental engineers can know at first-hand from the English Press what is being done in the British Empire, while many of our engineers can only know what engineering developments go on in foreign countries by reading translations of the technical Press.

The amount of study required to give one a working knowledge of a foreign language, sufficient to be able to read foreign publications, is perhaps over-estimated. Good progress in learning to read the foreign Press can be made by an individual who purchases, say, a Spanish grammar and dictionary, and then studies privately by reading novels in such a way as to understand the main story of the novel without endeavouring to read every line; the latter process may be necessary at school, so as to translate each sentence correctly for the schoolmaster, but it is not conducive to reading much literature. One does not need to look up every unknown word in the dictionary, but goes on reading even if some words are unknown. This method does really work; such reading of novels will not teach one to speak the language, though it helps one in obtaining a vocabulary to use when the pronunciation has been learnt; but after reading twenty or thirty novels in a foreign language, one will be able both to enjoy the foreign literature and to glean items of interest from the technical Press.

If one reads while travelling, standing, or sitting in tramcars and trains, one cannot always be looking up words in a dictionary; therefore one must either stop reading foreign books in such cases, or go on reading without troubling if some words are not understood.

Access to foreign literature suggests to one what parts of our conventions and ideas are insular and not universal. This can be learnt partially by reading books of travel and history, but is better learnt by reading novels dealing with the life in foreign countries. One is always able to learn about something in which the foreign nation is ahead of our own. No nation is absolutely better than every other nation in every department of life, including government, sport, medicine, education, literature, music, painting, engineering, and science.

As regards science in particular, one should be able to read German text-books if one wishes to get *very detailed* information on technical subjects. The expression "very detailed" is used because of a remark made by a Swedish professor to the author. He said that Swedes liked English medical text-books in preference to German books, because the English ones gave the main substance of the matter, whilst the German books gave an immense mass of details along with the substance, and the books became so bulky that it was difficult to reach the substance at all. The criticism seems reasonable.

If members of Parliament, labour leaders, councillors, lawyers, and men who draw up rules and regulations had more direct knowledge of what went on in other countries, probably engineering progress would proceed more quickly, and Parliamentary regulations regarding electrical matters might become less irksome.

HIGH-FREQUENCY STRAY SPARKS ON MOTOR CARS.

By "VOLTMAN."

Truly, we live in strange times. The man-in-the-street seems to be in a fair way of developing a super-scientific brain. Of course, one is well aware that the daily Press regales him from time to time with wonderful and somewhat fearful articles on the latest marvels of science, served up with all manner of popular trimmings, and after reading such an article one concludes that the man-in-the-street is very prone to rush along paths of super-science where a Faraday or a Kelvin would have feared to tread. These ideas came into the writer's mind when a very ordinary owner of a motor car—and a cheap one at that—stated that he could get "high-frequency sparks" by lightly touching the petrol tank with a spanner. He averred that he could see the alleged high-frequency sparks distinctly in the dark when the engine was running. The writer suggested that if this were so our friend might possibly have made an important electrical discovery, but so far as the writer was aware, an ordinary motor car was not regarded by the electrical *cognoscenti* as a perambulating generator of high-frequency oscillatory discharges. The writer doubts whether our super-scientist could give an intelligible explanation of why a magnet deflects a

compass needle, yet here was he descanting on his magneto radiating high-frequency oscillations as the result of "spark gaps, condensers, and capacity"!!

The high-frequency effect, he averred, fully explained why some motor cars had been known to burst into flame by ignition of the petrol when on the road and leave nothing but a charred and tangled mass as evidence of the disaster. Assuming our friend was accurate in his observations, there is quite a number of interesting little problems connected with the origin of stray sparks on motor cars generally. The writer can vouch for some that are not explainable by ordinary reasoning. It is necessary to keep in mind that a motor car is an all-insulated, large-capacity mass of metal. The insulation resistance, with clean dry tires, may be anything from 3,500,000 to 4,500,000 ohms. All the metal of a car serves more or less as the return circuit for high-voltage current, and also for low-pressure currents when single-wire lighting and starting outfits are used. Furthermore, it is true that the magneto provides the essentials of a high-frequency generator; there is, in fact, much more in its functioning than meets the eye, as research has proved. It does more than merely produce a small spark at the plug. From observation, the writer can give a few instances of stray sparks. In one case heavily-insulated high-pressure leads from a coil to the plugs passed through a brass tube to keep them together. In complete darkness a ring of minute sparks could always be seen between the end of the tube and the insulation on the leads, this insulation being in excellent condition, so that there could be no question of leakage. Doubtless in this case there was an electrostatic and condenser effect between the leads and tube. Another interesting instance showed that some stray sparks take place at loose metallic joints on the mechanism despite the fact that there exists an excellent return circuit from the plugs *via* the engine back to the magneto, this circuit having practically no resistance. To make doubly sure of a good return, a wire was connected directly from the engine to the magneto base. Nevertheless, the sparks still occurred at the loose joints and a long way from the engine. If, as seemed improbable, these sparks did not indicate that there were wandering currents finding a way back to the magneto, it must be reasonably assumed that these sparks were the result of the aforesaid high-frequency effect. Each loose joint, which, of course, is in a state of vibration, would function as a coherer or detector acting in sympathy or unison with every discharge from the magneto. There certainly seemed no reason why return-circuit currents should be passing through these loose contacts, and the true source of these seems to offer a good field for investigation. Perhaps our friend the man-in-the-street did, after all, really see high-frequency effects!

AN AID TO METER TESTING.

By R. M. M.

"Curse——& Co.! Another batch of faulty meters!" Such a remark may be heard after a preliminary test on some freshly-delivered meters in a test room which is not provided with adequate facilities for observing the variation of the test load.

Scales not sufficiently open, use of instrument on a lower ranger of scale, or simple variation, may have been the real fault which caused the tester to swear. The volt or amp. boy may be intelligent, he certainly will be human, and may suffer from astigmatism. The boy's power of observation of 1-10th of one scale division will decrease in proportion to the length of any one test, and set of tests, so that by the time the tester has reached the twelfth meter, say, allowing for 50-second counts per meter, the probability of current variation being unnoticed is greatly increased. That 1-10th of one division at 10 divisions is 1 per cent. is obvious.

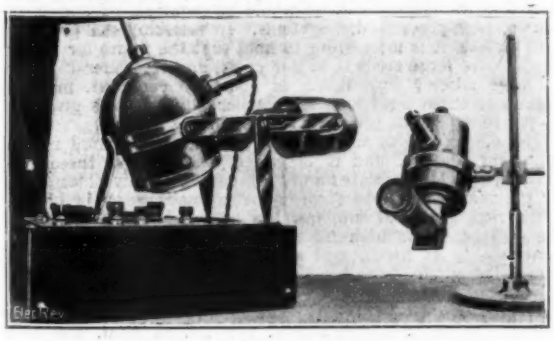


Fig. 1.—Large and Small Projectors.

To obviate this trouble a small apparatus was recently designed, by means of which the image of the pointer and the image of the reflection of the pointer can be projected on to a screen, situated in such a position that the tester can see the images (coinciding) indirectly, but comfortably, and can readily see any variation at the same time as he is taking a count. Further, if the tester has a small two or three-plate carbon resistance handy, he can correct for a small variation without stopping his test. As the image is considerably magnified, 1 per cent. can be arranged for 1 in. travel on the screen.

The accompanying illustration (fig. 1) shows a large size projector, on legs, but in actual practice it would be found more convenient to suspend this on a bracket, so as to allow horizontal rotation to give projection on one or other wall. The instrument would be supported on a pivot base, arranged so that the pointer could be brought under the projector at any part of the scale. The smaller projector shown is on an adjustable stand, but the suspended type is thought to be more useful.

Fig. 2.—Projector in Use.

* Position of Image of Pointer.

The other illustration (fig. 2) shows the resultant projection photographed in broad daylight in a test room with one east and two north windows, or under rather trying conditions.

It is, of course, simple to construct a scale or scales

exactly corresponding to the standard instrument used, and corresponding to the distance of projection, or, alternatively, under certain conditions, the image of the actual scale can be projected. Both the projectors illustrated consist of: An optical mirror; a 12-volt motor-car type head lamp; a condenser; a plane-surface optical mirror; and a focusing lens.

If anyone considers building such a projector, it is important to remember the following details: the flatter the angle of projection the better; the plane-surface mirror must be fixed so as to be able to rotate through a sufficient angle to allow for the desired height of projection; the light source itself must be capable of being moved to suit the depth from the surface to the mirror below the pointer; and good ventilation is required for the lamp. The forms illustrated are not the best, but were made up from odds and ends of material at hand. In a slightly modified form the instrument can be used to project the image of any pointer or indicator.

LEGAL.

Edison Swan Electric Co., Ltd., *v.* Lawrence.

On December 20th, Mr. Justice Rigby Swift heard an action brought by plaintiffs against Mrs. Mary Eliza Lawrence, a widow, of Anna Terrace, Torquay, to recover £184 8s. 11d. under an agreement in writing dated December 13th, 1920, by which defendant agreed to guarantee payment of 5s. in the pound upon a claim against Wilfred Lawrence, such payment to become due at the expiration of nine months. Defendant denied liability on the ground that she was not aware when she signed the guarantee that he had entered into a deed of assignment with the trustee of his creditors.

Mr. Storry Deans appeared for the plaintiffs, and Mr. Stokes for the defendant.

Mr. Storry Deans, in opening, said that in November, 1920, plaintiffs issued a writ against Wilfred Lawrence for £895, the price of goods sold by them for use in his trade as an electrical engineer. Upon the writ being served he put himself into communication with the solicitors for the plaintiffs, and also with a firm of chartered accountants. A meeting of the creditors of Wilfred Lawrence was held in December, 1920, and the debtor who attended offered to pay 20s. in the pound, but the creditors were not disposed to accede to this unless he should give some security. Eventually it was agreed that he should pay his creditors by instalments of 5s. in the pound, by four quarterly instalments, and that he should assign his business to a trustee. It was also decided that as to the last two quarterly instalments he should provide a guarantee. He did so, and his mother, the present defendant, became the guarantor, and this action was brought under the document to recover one instalment of the amount due to plaintiffs by the son.

Mr. Stokes, for the defendant, contended that the form of guarantee sent to Mrs. Lawrence was a misleading document, and was therefore void. Plaintiffs omitted to disclose the fact that the debtor had already divested himself of all his assets.

His Lordship, in giving judgment, said he believed that the defendant did not know of the arrangement with her son's creditors when she signed the guarantee. She thought she was merely guaranteeing a trade debt to prevent legal proceedings continuing, and thus obtain for her son an extension of credit. He decided that the consideration wholly failed, and there would be judgment for defendant with costs.

Wrongful Connections to Mains.

At Worksop, on December 14th, Horace Barrow, a contractor, of Park Street, Worksop, was fined £3 on a charge of connecting electrical wires to the cable belonging to the Worksop Urban Council without consent.

Defendant gave notice that he required a meter for a 2-h.p. motor, and the installation was accordingly made. The Council afterwards accidentally found out that certain other wires had been fixed, and thereby defendant obtained light and heat for a radiator and other purposes. Defendant was a wiring contractor, and had a knowledge of what he was doing.

Barrow pleaded guilty, and said his men were warned about the matter.—*Sheffield Daily Telegraph.*

Accumulators, Ltd., *v.* Australian Commonwealth.

According to the *Sydney Morning Herald*, of October 25th last, recently received, in this action Accumulators, Ltd., an Australian company, formed about three years ago for the supply of electrical batteries, sued the Commonwealth Government to recover £1,231, charging a breach of agreement in connection with a contract to deliver certain parts necessary for the erection of a counter e.m.f. battery for the Postal Department in connection with the telephone exchange business. Plaintiffs stated that they packed and delivered the material ordered and fulfilled all the required conditions, but the defendants declined to pay for it. Several pleas were filed by the defendants, traversing the plaintiff's declaration, and setting up that when the battery was erected it was found that it would not carry the stipulated current continuously for three hours without excessive heating. They, therefore, refused, as they lawfully might, to accept the material, and requested the plaintiffs to remove it from the premises. Defendants also entered a plea of cross action, claiming damages for delay and inconvenience in excess of the amount claimed by the plaintiffs.

The case was part heard.

Charge of Stealing Lamps.

At Bow Street Police Court on 23rd inst., Edward Alexander Kann, 35, was sentenced to six months' imprisonment in the second division for stealing Osram lamps, belonging to his employers, the General Electric Co., Ltd. The earlier hearing was reported in our last issue. On December 23rd, according to *The Times*, the thefts had been going on for about 12 months, and had involved the company in a loss of nearly £2,000.

REVIEWS.

Power House Design. By Sir John F. C. Snell. Second edition, 1921. Pp. 535; figs. 201. London: Longmans, Green & Co. Price 42s. net.

A second edition of Sir John Snell's valuable work will be welcomed at the present time, when the important question of adequate supplies of electrical energy is receiving attention not only in Britain and the Dominions overseas, but in nearly every industrial country in the world.

A period of ten years having elapsed since the original edition was written, many important developments in power house design have taken place, and the author has taken the opportunity to rearrange the subject matter and bring it up to date, whilst some of the chapters have been entirely revised, and the minor typographical errors of the first edition corrected.

The aim of the author has been to give reliable and up-to-date information on the design and equipment of various types of power stations for the supply of cities and wider areas, and also for railways, mines, and factories, or where smaller independent power houses and sub-stations have to be designed and constructed.

The subject matter has been conveniently arranged in twelve chapters, and a feature of the book is the tabulation of useful data and costs, &c., the latter being on a pre-war basis, so that for estimating purposes a correction factor can easily be applied to suit the particular conditions obtaining.

In the opening chapter, systems of supply are considered, and the author makes a strong plea for the standardisation of voltages and frequencies, recommending 6,600 volts as a reasonable maximum generator pressure, and showing that only four standard pressures would be required, excepting, of course, high-pressure d.c. systems. In assessing the probable load factors, it is interesting to note that the figure for power supply over large areas is 35 per cent., and for general supply to large cities a load factor of about 30 per cent. may be expected; these figures in the earlier edition were given as 25 per cent. and 22 per cent. respectively.

The choice of site and type of plant are considered in the following chapter, and it is clearly shown how these two matters are closely related and also may be wholly determined by the character and location of the ultimate source of power. With regard to coal supplies, the figures given in Table IV are still based on high-grade coal of 13,500 B.th.u. per lb. (presumably as fired), and although great improvements in thermal economy have been made in the past ten years, the consumptions quoted do not take this into consideration. If we assume a 60 per cent. load factor and coal having a calorific value of 13,500 B.th.u. per lb., as fired, the heat consumption per watt-hour generated would be 34.7 B.th.u., or an overall efficiency of only 9.8 per cent. Unfortunately, coal of this value is the exception and not the rule in this country, and if it were available it would be a comparatively easy matter to obtain an overall thermal efficiency of at least 13 per cent. on this load factor with up-to-date steam plant, whilst a figure of 18 per cent. is now possible, including stand-by losses.

Power-house buildings are considered in Chapter III, and the data regarding foundations and loading on various subsoils should prove useful to the designer, whilst the importance of piling and rafting the subsoil in the case of most large modern waterside stations is referred to, and examples are given. Reinforced concrete receives brief mention, but in view of the economies that can often be effected by its use, it is disappointing to find less than half a page devoted to this type of construction.

Chapter IV is devoted to steam-raising plant, and many

useful data have been included, the text having been revised and brought up to date. In Table XVI particulars of standard Lancashire boilers are given, but the evaporative capacity has been based on a coal of 13,500 to 14,500 B.th.u. per lb., and properly proportioned economisers are assumed. A useful table of particulars of the B. & W. marine type boiler is given, but the actual evaporations quoted appear to be based on high-grade coal, and the author mentions that the normal output is obtained with a consumption rate of about 22 lb. of coal per hour per sq. ft. of grate area. Nowadays, however, the power-house engineer in this country has to be content with coal of from 10,500 to 11,000 B.th.u. per lb., as fired, with, of course, a higher consumption rate per sq. ft. per hour, and a diminution in efficiency.

CO_2 recorders are mentioned, and it is recommended that one should always be fixed to each range of boilers; in modern practice it is becoming more usual to provide an indicator or a recorder for each boiler, except, of course, in very small stations. Useful notes are given on boiler draught and coal storage and handling, but it is disappointing to find no data regarding modern ash-handling plant, and only some fifteen lines devoted to the whole question of ash disposal.

The author gives some brief details of oil-fired boilers in this edition, and it is interesting to note that it will generally pay to burn crude fuel oil (18,000 to 19,000 B.th.u.) when its cost does not exceed one and a half times that of good steam coal (14,500 B.th.u.) or one and three-quarter times that of bituminous coal (11,500 to 12,000 B.th.u.).

Gas firing is also mentioned, but few data are given, possibly because test results are difficult to obtain, and gas-fired boilers at present can hardly be regarded as part of the usual power-house equipment.

Steam and feed-pipe systems are considered in the following chapter. In Table XLIV, the properties of saturated steam up to 500 lb. per sq. in. abs. are tabulated, the authority being Marks & Davis, 1909, but no data for superheated steam have been set out, and Callendar's values are usually considered to be more up to date.

Chapter VI is devoted to steam engine and turbo-generators, and forms naturally one of the most important sections of the book. As in the former edition, the author considers that generally the limit of size up to which reciprocating engines may be used is about 750 kW. In view of the developments of geared turbines and the fact that there is not much to choose between the reciprocator and the turbine in either capital cost or heat consumption in small sizes, the reviewer is inclined to place the limit at about 500 kW, and recent figures quoted tend to place it even as low as 350 kW. 350 kW.

Regarding reaction turbines, the author is careful to point out their inherent weaknesses, although little is said of the modern improvements effected in construction, and no mention is made of the new Parsons type of blading.

There is an absence of really up-to-date test results for either impulse or reaction machines, and it seems a pity that turbine manufacturers are so jealous of their results that the most up-to-date information is not readily available for publication in a work of importance.

The subject of condensers is considered in Chapter VII, and some useful tables and costs are given, although it is rather disappointing to find that the most up-to-date types of air pumps and auxiliaries are not dealt with, and as in the former edition a considerable amount of space has been devoted to jet condensing plant.

Chapter VIII deals with gas engines, gas producers, and oil engines, and it is interesting to note that the author considers that the i.c. engine in its present state of development is only economical from the aspects of both capital and running costs in stations of small or moderate capacity. In connection with power gases, methods of gasifying fuels are considered from a power-station engineer's point of view. Regarding solid fuels for gas production purposes, the formula given on page 257 in the first edition has been corrected, and its value enhanced by the caution given as to the effect of higher oxygen contents when compared to calorimetric determinations.

A chapter of practical notes on generators, motors, boosters, and transformers follows, and contains particulars regarding the specification and construction of electrical plant. The description of a typical turbo-alternator is similar to that given in the former edition some ten years ago, although great progress in design has been made in the interval. With regard to alternator rotors, mention of solid-core designs, and water cooling, has been omitted. Commutation difficulties on turbo-generators are referred to, but surely these are troubles of the past. With regard to tests on insulating materials and temperature limits, &c., no mention of the British standard specifications is made, although nowadays the purchaser is more or less obliged to keep to standard specifications unless cost is a secondary consideration. In connection with works auxiliary transformers, the author now recommends a secondary pressure of 415 volts for motors and 220 volts for lighting, but no mention is made of the convenience of adopting a pressure of 240 volts for the lighting, so that a supply can be obtained if desired from the same 415-volt transformers. Table XCIX gives particulars of standard static transformers, but as in the former edition, the outputs are only tabulated up to 50 kVA.

Switchgear is considered in Chapter X. The lay-out of the Greenwich switchgear is selected probably as being typical of a large 3-phase power house, but of course great improvements in control gear have been made in the last ten years, and one is somewhat disappointed to find so little space devoted to enclosed types of gear. Modern practice dictates that reliability is a prime consideration, and to this end the adoption of a separate switch house and completely enclosed control gear is warranted in stations even of moderate capacity. The Dalmarnock power station in Glasgow is probably the most up-to-date example of switchgear lay-out, but no description of this gear is given, and only brief mention of it is made elsewhere in the book. The author gives some of the salient features of a typical specification for 3-phase high-pressure switchgear, and still includes a reverse-current relay as part of the generator equipment, whilst the absence of some type of automatic fault protective gear and of an automatic field-breaking switch are noticeable omissions.

Chapter XI is devoted to a consideration of some of the salient features of large and small power houses and substations, and the subject matter has been entirely revised and brought up to date, so that it contains much of value to designers. Brief particulars are given of the lay-out of some typical waterside power houses, and some useful estimates of the capital costs of power houses are given. The author goes fully into the question of combined by-product recovery and generating plant, including the findings of the Nitrogen Products Committee's Final Report of 1920. Finally, waste-heat utilisation is considered.

Hydro-electric power houses are dealt with in the last chapter, and the subject matter has been revised and brought up to date. Water turbines of various types are considered, and the more modern method of comparing machines on a specific speed basis has been incorporated in the present edition. Convenient tables of capacities, sizes, and costs of reaction and impulse turbines are given.

The book is most lucidly written, free from mathematical formulæ, and exceptionally well illustrated, so that as a work of reference for professional engineers it will prove convenient and valuable.

The author has been most successful in collecting and classifying the experiences of eminent engineers, and in drawing upon his own knowledge in incorporating the information into a really valuable volume which will become the standard work on the subject of power-house design.

L. M. J.

The Testing of Continuous-current Machines. By C. F. Smith, D.Sc., M.I.E.E., A.M.I.C.E., Whitworth Scholar. Pp. x+109; 21 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

This small book forms one of the numerous volumes on engineering included in Messrs. Pitman's Technical Primers, and in it the error, so common in books of this class, of attempting to cover too great an amount of ground in too small a space, has been carefully avoided.

The first chapter deals with the general principles of direct-current dynamos and motors, and is followed by others dealing respectively with measurement of resistance and temperature rise, no-load tests on machines, load tests on generators, and load tests on motors, in which all the tests likely to be of usual application in ordinary test-bed work are adequately described.

With regard to the methods of taking insulation resistance, it would be well to point out that, when taking an insulation test on a running machine by noting the pressure between each terminal and the frame and between the two terminals, the machine must not be connected to an external circuit, otherwise the result obtained will not be the insulation resistance of the machine itself. The diagram for the series Hopkinson test on p. 72 contains a slight error, as the voltmeter connection shown would short-circuit the supply pressure (the single-pole switch should be shown on the other side of the instrument), and in the formula for the losses in a series motor (using Field's method) given on p. 95 a printer's error has apparently resulted in a mixing-up of the various suffixes.

Apart from these small points, which will doubtless be put right when a further edition is required, the text is accurately written, and the "get up" of the book does credit to the printer and publisher.

The work can be heartily commended to assistants on machine test beds and to students taking a practical class in the testing of direct-current machines.

The Steam Turbo-alternator. By L. C. Grant, A.M.I.E.E. Pp. xvi+260; 160 figs. London: Sir Isaac Pitman and Sons, Ltd. Price 15s. net.

In writing this book the aim of the author has been to give the reader a good general knowledge of the principles, construction, and operation of the steam turbo-alternator, so that recourse to specialised text books on either steam turbines or alternators will be unnecessary.

The dual nature of the subject matter and the fact that the work has been written to suit the needs of engineering students, central station engineers, draughtsmen, and others who are interested in the steam turbo-alternator combination,

have rendered the author's task a somewhat difficult one to perform.

The steam turbine is considered in its various details in the first six chapters, whilst the succeeding eight chapters are devoted to alternating currents and the theory and construction of modern alternators, followed by sections on control apparatus, operation notes, and examples of modern practice.

In connection with the notes on the development of the turbo-alternator, the illustration of a 7,500-kW, 1,500 r.p.m. turbine erected alongside one of the 4,000-h.p., 75 r.p.m. engine-driven alternators in the Glasgow tramway power house is quite interesting, and brings back to the reviewer memories of many anxious times on the e.h.t. control board and the effects of heavy flywheels.

Steam flow in reaction and impulse turbines, pressure and velocity changes and the effects of variations in pressure and temperature are considered in Chapters II and III, and the Emmet mercury-steam turbine is briefly described. On p. 31 a curve of efficiencies at various pressures and temperatures is given, but its value is somewhat doubtful owing to the errors in the accompanying text. The feed-water temperature is given as 800 deg. F., and the efficiency ratio is expressed as the amount of heat which can be utilised when compared with the total heat content of the fuel. The feed-water temperature should doubtless be 80 deg. F., and the "efficiency ratio" is probably intended to be the available heat per lb. of steam divided by the total heat per lb. of steam.

In considering the power available and the efficiency ratio, the author gives the theoretical steam consumption as:—

$$2545/\text{Available heat per lb. of steam}$$

instead of the more convenient expression, using the value of 3415 in the numerator, which gives the consumption in lb. of steam per kWh instead of per h.p. hour on the shaft. "Indicated h.p." and brake h.p. tests can only be conducted on small turbines, and such terms are of little commercial importance in connection with turbo-alternators. Rankine cycle efficiency assuming isentropic expansion is not explained, whilst somewhat loose expressions such as "lbs. per square inch" and "a few ounces pressure to the square inch" occur in the text. It is usual nowadays to express expansion down to condenser pressures in inches of mercury (abs.) back pressure, or lb. per square inch (abs.).

In Chapters IV and V, steam turbine details are considered, and some interesting particulars of modern machines are given. Under the subject of rotors, the Michell thrust bearing (spelt Mitchell) is mentioned, but no illustration of it is given. Constructional details such as rotors, types of blading, packings, couplings and bearings, &c., are described and illustrated, whilst lubrication and governing systems are fully dealt with.

Before dealing with the theory of alternators, the author gives a chapter on alternating currents, but here again one comes across some rather loose expressions in the text. Ohm's Law is not defined in the usual manner, and an equation is merely given that $E = I \times R$, where E is the voltage, I is the current, and R is the resistance, although it is assumed that the law has been stated. Inductance and capacity are then considered, but the author does not take the trouble to explain his formulæ or even state the units of measurement. Frequency is denoted by the equation: $f = 2p \times n$, where $2p$ is the number of pairs of poles and n is the revs. per second, although the number of pairs of poles is usually given by $p/2$ or simply by p. On p. 101 in the equation for average e.m.f., the denominator of 108 is obviously a misprint, but later the author states that the work done in a circuit is proportional to the square of the current, although he is considering the e.m.f., and there is no mention of work or energy units. Figs. 55, 56 and 57 do not appear to have any connection with the text of the chapter. The characteristic features of single and polyphase alternators and alternator windings are considered in the two following chapters, but on p. 122, in considering the relative outputs, the three-phase grouping is given as 0.51, whereas a factor of 1.51 is probably intended. Alternator output is next considered, and the author shows the importance of limiting temperatures to a safe figure. A safe final air temperature of about 130 deg. F. is mentioned, but as this figure is based on an engine-room temperature of 90 deg. to 100 deg. F., the available temperature rise is only some 40 deg. F. The usual or conventional figure of 40 deg. C. temperature rise is not mentioned, and a normal engine-room temperature of 90 deg. to 100 deg. F. is not the usual practice in this country, whilst the B.E.S.A. figures are not referred to in this chapter. The constructional details of alternators are described, and notes on up-to-date features, such as air filters and thermo-couples, are given in the following chapter. Excitation and regulation matters are dealt with in a practical manner, and short circuits and other troubles are considered in an interesting section which follows. Reactances, harmonics, and the earthing of the neutral are dealt with in turn and useful practical notes given. Chapter XIV is entitled "Generator Tests," and methods of determining the various losses are explained, although the details given are necessarily very brief. Control apparatus next receives the author's attention, and notes on switchgear and protective devices are given. Reverse current relays are not usually considered desirable on modern alternators, and overload time-limit protection is hardly a sound method to adopt if the trip solenoids are shunted by fuses. Protective gear is described with the aid of diagrams, and notes on synchronising apparatus are given, the Weston synchroniser being illustrated. "Miscellaneous notes on operation and maintenance" is the heading of the next chapter, and practical hints on running and repairs are given. In starting up turbines, the author advises a period of at least three hours' preliminary warming up, and after warming up is completed the circulating and other pumps should be got away. Three hours is an unusually long period, and if the rotor is at rest, trouble is likely to occur with reaction machines on running up, whilst overheating at the exhaust and condenser can easily happen under the conditions stated. The final chapter is devoted to examples of modern practice, and some interesting details of existing machines are given, whilst the importance of higher power-house efficiencies is considered. An appendix gives useful notes on various steam and electrical matters referred to in the text.

On the whole the book is a very fair practical exposition of turbo-alternator practice, and should prove useful to students and operating engineers who desire to obtain a good general knowledge of the subject without having recourse to the more conventional text books or technical papers dealing chiefly with turbine design or alternating-current theory.

L. M. J.

AERO ENGINE IGNITION.

(*Concluded from p. 836.*)

Potential Wave-Form of a Magneto.

Potential Wave-Form of a Magneto.—A fourth report, No. 47, September, 1918 (I.C.E. 241), by Dr. N. R. Campbell, shows that accurate knowledge of the wave-form is not as important as had been suggested. For it appears that the efficiency of the magneto as a means of producing ignition is by no means closely related to its wave-form; since, provided the necessary maximum potential is reached, it matters little or not at all in what way the rise to that potential takes place. So long, therefore, as it is only a question of determining which of several magnetos already constructed is likely to be the most efficient, a knowledge of the wave-form is not required.

On the other hand, if an attempt is to be made to design the magneto which will give the greatest maximum potential for the least weight and subject to the satisfaction of the necessary mechanical conditions, then a determination of wave-forms is almost necessary if any but purely empirical methods are to be used. For the inductances (and to a lesser extent the capacities) of the primary and secondary circuits vary so rapidly with the frequency of the oscillations passing in those circuits that it is necessary to determine the inductances at the frequencies which will be actually used; a knowledge of the frequency is thus needed and can only be obtained by some method which is equivalent experimentally to the tracing of the wave-form.

I. The first method investigated was that of the oscillograph. Since the frequencies of the oscillation in a magneto are of the order of 10,000 per second, the kathode-ray oscillograph (similar in principle to the Braun tube) seemed much more promising; such instruments are known to deal satisfactorily with oscillations of much greater frequency. But the difference between the widely separated impulses given by the magneto and the regular trains of waves to which the Braun tube has been applied, introduced almost insuperable difficulties.

II. The second method is that of the Helmholtz interrupter, in which the connection between the secondary terminals and the measuring instrument is broken at a known interval after the interruption of the current in the primary. In any "point-to-point" method, the determination of each point on the wave-form involves a separate experiment; it is absolutely necessary, therefore, that the wave-form should be identical in successive experiments. In a magneto this condition is not fulfilled.

When the problem was attacked once more, efforts were directed primarily to producing a more satisfactory break. If no attempt is made to design a break which will work continuously (like the cam-operated break of the magneto), there is no difficulty in securing accurate and regular timing. But even when the timing is accurate and consistent there remains the difficulty that the peak potential attained at successive operations of the break is not the same, but may easily vary by 20 per cent. It was finally discovered that much greater regularity was obtained if the rate of separation of the contacts (or at least the speed of the moving part which caused that separation) was decreased and not increased. In a subsequent report it is hoped to give a more detailed account of the circumstances which tend towards regularity at break; here it will suffice to say that, by reducing the speed of the part operating the contacts to 1 metre a second or less, it was possible to produce a contact which, at successive operations, would give peak potentials agreeing to 1 or 2 per cent. With such a contact a point-to-point method of tracing the wave-form becomes practicable.

Accordingly, the magneto armature was kept at rest, in the position relative to the pole pieces at which break occurs when the armature is rotating, and the current from an

external battery passed through the primary and broken by a pendulum.

Fig. 4 shows the secondary wave-form of a Thomson-Bennett magneto when a current of 2 amp. is broken in the primary and the armature is in the position which makes all the inductances a maximum. There was no spark gap in the secondary circuit. To indicate the consistency of the measurements *all* the experimental points are shown.

A full discussion of the significance of these results is reserved until more complete material is available, but a few points may be noted. The oscillations in coupled circuits are compounded of two damped harmonic vibrations, the frequencies of which are different from those of either of the two circuits when uncoupled. The ratio of the frequencies of the two harmonics depends chiefly on the coupling of the

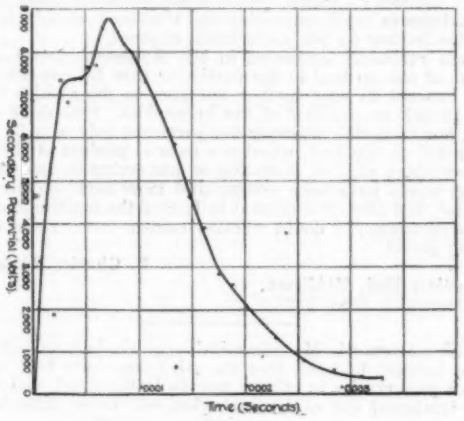


Fig. 4.

two circuits. In order that the secondary potential should be a maximum for a given value of the primary current, it is necessary (but not sufficient) that the coupling should be such that this ratio has one of a certain series of values which makes the peak of the harmonic of lower frequency coincident with one of the peaks of the harmonic of higher frequency.

In fig. 4 the presence of the two harmonics can be traced clearly. That of lower frequency is represented by what appears to be the main oscillation, while the harmonic of higher frequency is represented by the slight "hump" on the steep initial rise of the curve. Further, the frequencies in the secondary and primary circuits are very nearly the same, and the oscillations in the two circuits are very nearly in the same phase. The period of the harmonic of lower frequency is increased by the addition of capacity to the secondary, but it is not certain yet what change has been effected in the higher harmonic. These results are in complete accord with the theory. But the curve shows also that the coupling of the circuits is not such that the maximum secondary potential is attained, for the peak of the harmonic of higher frequency does not coincide with that of the harmonic of lower frequency; an alteration in the coupling should produce a more efficient machine. Again, the very heavy damping of the oscillations should be noted; if this damping could be reduced, the peak potential might be raised considerably, but since the damping is probably mainly due to iron losses, it is not certain whether any improvement in this direction is practically possible.

III. A third method of determining the wave-form was suggested by Mr. F. Young, of the British Thomson-Houston Co. It depends on the use of the rotary spark gap, but cannot give the time at which a given potential is attained for the second or any subsequent time. This limitation prevents the method giving all the information which is required. The method is feasible for obtaining at least an estimate of the periods concerned in the wave-form; it is capable of great improvement, but cannot compete with the point-to-point method in accuracy, and will not give the complete wave-form.

Spark Synchronism.—A fifth report, No. 22, January, 1918 (I.C.E. 171), contains a description by Dr. G. E. Bairsto, A.M.I.E.E., of tests that show that the synchronism of the sparks of a left and right-hand Dixie magneto, timed correctly, when at rest, may be out by as much as 2 deg. at engine speeds, which may cause, in certain cases, a drop in engine power of from 3 to 4 per cent. when using dual ignition.

The source of these irregularities is to be found in the contact breaker, which in a Dixie magneto is stationary, and is actuated by a rotating four-break cam. The fibre block in the right-hand magneto is struck by the crown of the cam in the usual manner, *i.e.*, on the inside edge (fig. 5A). On the other hand, the contact-breaker of the left-hand magneto, instead of being turned through 180 deg. (*i.e.*, inverted like the reflected image in a mirror) to suit the opposite direction of rotation, is kept the same, and the cam therefore strikes the fibre block on the outside edge (fig. 5B).

The only alteration that is made to the magneto is to turn the cam through a small angle corresponding to the arc subtended at the centre of the cam by the length of the fibre block. As the accompanying diagrams show, the actual forces on the cam are quite different in the two cases. In the case of the left-hand machine the impact is of a glancing nature and gives the contact-breaker arm an opportunity to rebound and make contact again before it is finally opened, thus giving two sparks. This point is still under investigation.

Using dual ignition with two magnetos, one a left-handed one and the other a right-handed one, the result of this abnormal behaviour is to cause the two sparks, which synchronise at very low speeds, to alter in phase in some cases to as much as 2 deg. (*i.e.*, one retards by ¾ deg. to 1 deg. and the other advances 1 deg. to 1¼ deg.) when the engine runs at top speed. The benefit of using two sparks simultaneously firing two plugs is thus to a great extent lost. Actual tests on engines have shown that this may cause a drop in power of from 3 to 4 per cent. below that obtainable with two perfectly synchronised sparks.

Where dual ignition is used, it is recommended that as far as possible the Dixie 8-cylinder magneto with left-hand direction of rotation be not used. A compromise might be made, which will, however, not meet all cases, by timing the two magnetos differently, the left-hand one 2 deg. in retard behind the right-hand one.

Magneto Faults.—The report on this subject, No. 18, August, 1917 (I.C.E. 138), is also by Dr. G. E. Bairsto, and comprises a summary of the experience gained at the Royal Aircraft Factory during the two years ended August, 1917:—

American and London Bosch.—This type may be considered as fairly reliable. The total percentage of rejections was 16½ per cent., and the very large number of machines which fired at the safety gap illustrates the inherently weak design of the safety gap which is used on the D.V. type of Bosch magneto.

B.T.H. (A6 and A8).—The chief objection to the B.T.H. magneto is the lack of refinement in constructional details. Only one 12-cylinder magneto has been tested so far, but a number of small defects still remain to be eliminated before it can be called satisfactory.

Dixie. (6, 8 and 12 cylinder.)—Very compact, sound in the *general* electrical design, but the workmanship in many parts is inferior. The design of the magnetic-field path is also weak. More insulation is required in places, and the design of the safety gap needs alteration. Out of 12 machines so far tested, only three were satisfactory, but in nearly all cases modifications made to the faulty machines enabled them to pass the tests.

Fellows. (F.R.4.)—A copy of the Bosch D.U.4. Twenty-nine of these magnetos have been tested and only one has been rejected. They are well made, but no larger size than a four-

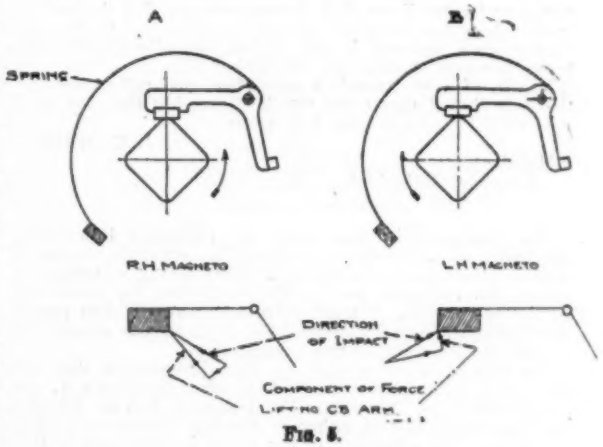


Fig. 5.

cylinder machine has been tested, so the reliability of a magneto made for more leads than this number is not known.

Simms. (6 cylinder.)—Only four of these have been tested and all failed to pass the tests. The workmanship is excellent, but more attention should be paid to the tuning and timing. All the above rejected magnetos ran satisfactorily when fully retarded, but failed to do so when fully advanced.

Peel Conner. (6 cylinder).—Practically a copy of the Bosch D.U.6. Only three have been tested, but these have given full satisfaction. The manufacture is excellent.

Watford.—Only three machines have been tested, but all were defective.

Berling. (8 cylinder.)—This magneto cannot be considered as satisfactory.

Ruthardt.—Very unsatisfactory and discarded completely.

Morris & Lister. (A.D.S.)—Fairly satisfactory, but the workmanship is not perfect.

Hollister. (12 cylinder.)—Only one of this recent type of magneto has been tested. It is an experimental machine,

and of very excellent manufacture. It has several novel features which overcome some of the existing sources of trouble. The arrangement of the field magnets does not, however, seem to give the best possible results, as the secondary voltage is not high enough to give the sparking qualities desired.

Coil and Battery Systems. Besides the above types of magnetos, experience has been obtained on the following three than that of either of the two following systems.

Remy (8 and 12 cylinder).—The constructional details in many points are very weak and have caused a lot of trouble. The design is sound and the synchronism of the sparks practically perfect. The current consumption, however, is greater than that of either of the two following systems.

Atwater-Kent (open circuit). (4 and 8 cylinder.)—The constructional details are perfect, and the machines are exceedingly well manufactured. They are very light, and the current consumption is low. On the other hand, the sparks are not perfectly isochronous, due to the mechanical lag in the contact breaker. The only mechanical defect that has occurred has been the breakage of the contact breaker "lifter."

Atwater-Kent (closed circuit). (4 and 6 cylinder).—This is full of weak points. The unit is, however, very light, and the current consumption low.

The report summarises the tests carried out, mentions the sources of trouble and suggests means of improvement.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Durability of Lead-covered Cable.

Your correspondent, Mr. R. Hampson, is to be congratulated on his very excellent letter on the above subject, but I am afraid he is not a regular reader of the REVIEW, or perhaps is too busy to study your advertisement pages, otherwise he would have been aware of at least one system which comes very near to his ideal. The system I refer to consists of a one-piece bonding ring, which clamps each cable independently, and a real universal connector box, which can be used as a four-way, tee, right-angle, or straight-through box, without alteration, and yet *be totally enclosed at any position.* No special cutting tools are required. Like our friend Mr. Raphael, modesty forbids me saying to which system I refer.

With reference to Mr. P. T. Kimmins's comments on the wiring at Lynton Town Hall, I venture to say that the trouble in this case was chemical contact corrosion due to the oak having been matured in salt water, or quite possibly the beams are part of some old oak sailing ship.

This is, of course, purely a suggestion, and put forward in the hope that it may assist you in diagnosing the case, as I note you are going to refer to it again.

J. C. White.

Manchester.
December 19th, 1921.

Mr. Hampson, in your issue of December 16th, while approving of lead-covered systems in principle, makes a general attack on the technical details of wiring systems, and directs his criticisms particularly to the one for which my firm is responsible. I trust, therefore, that you will permit me to reply, although a short letter from me has already appeared on the subject in this column.

The first objection raised by Mr. Hampson is that our junction box has four ways, so that, when used for a T, one way is left open. We assure Mr. Hampson that no objection has been raised to this, either by the fire offices or any other authority. The advantage of the 4-way junction box is that it can be considered "universal," and thus diminishes the number of accessories the contractor has to carry in his stock. We are ready to supply a 3-way box if there is any demand for it, and if Mr. Hampson desires a supply of a few hundred (for I am sure that he will adopt our system wholeheartedly after reading this letter), we shall be pleased to supply them. We have, however, sold many thousands of 4-way boxes, and have not yet had a single demand for a 3-way box. In the parallel case of the use of circular boxes in screwed conduit wiring, Mr. Hampson will find that a large number of leading contractors carry only 4-way boxes, and in surface work with screwed conduit it is quite a usual practice to leave one way open in dry situations.

Regarding bonding behind wood blocks, the criticism that a single centre screw is not sufficient security to keep the bonding ring in good contact with the cable has been raised before. There is no shrinkage if the blocks are of well-seasoned wood, and we do not think that Mr. Hampson need have any fear on this score in the case of the grooved blocks we supply for our system. On the other hand, I recognise that if the block is fixed to a plugged wall, there is a possibility of a plug working loose, and this can be guarded against by the simple expedient, well known in the contracting trade, of making a second hole and using two screws to fix the block, a practice on which many consulting engineers insist even in ordinary work. We are always ready to supply blocks with two fixing holes, if required, to save the second hole having to be made on the job, but so far there has been no demand for this.

The other "weak points" mentioned by Mr. R. Hampson do not occur in the Ediswan wiring system. The number of parts to be carried is extremely small, the cable fixers are standard for all sizes of cable, no special tools are required, and such few screw threads as are used are tapped into a thick iron backplate, not into soft metal.

I endorse Mr. Hampson's view as to the standard type of porcelain connector. It is not always satisfactory, and my firm has just placed on the market a new design—the Ediswan Acorn connector—which, although not so cheap, offers distinct advantages in rapid connection and absolutely certain contact, besides leaving no live screw-heads exposed.

I am extremely interested in Mr. Kimmins's letter on the action of oak on lead in the particular case he mentions, and look forward to your further reference to this, which I hope will include an analysis of the by-product. One thing is certain, however, that whatever the particular acid may be which has acted on the lead, whether a natural product of the wood or something used in seasoning or preserving it, its corrosive action would have been greater and more rapid on iron than on lead, and (dare I suggest it in face of the multitude of cab-tire enthusiasts?) I doubt whether rubber would resist it over a long period.

F. Charles Raphael.

Ponders End, Middlesex,
December 22nd, 1921.

With reference to Mr. Kimmins's remarks in your last issue, I am inclined to think that the oak beams have been treated with a preservative to kill the weevils in the wood, and during this treatment the cables had what was never intended for them.

The weevil-killing solutions are composed of various ingredients—some include solutions of mercury, others, strong washing soda or caustic potash.

Many of our jobs have cables running on oak beams, and I have to-day inspected a number and find them quite perfect, so I feel sure that the trouble has nothing whatever to do with the lead-covered cables being on oak beams. There are plenty of jobs in Gloucester which were wired with the B.I.W. system (paper insulation with lead covering) that are running on oak beams and have stood up for quite 20 years; these are not earthed or bonded.

Richard A. Parsons.

Gloucester,
December 19th, 1921.

The Installation and Use of Electricity in Coal Mines.

I read with great interest the letter from Mr. Travis with regard to the use and protection of electricity at coal mines when the supply of current is taken from large stations. The question of providing proper switchgear at the point of supply will be one that will require careful consideration, but I do not consider it beyond the ability of our switchgear manufacturers to supply a suitable apparatus.

Your correspondent, Mr. Millard, although he agreed with Mr. Travis, does not in any way indicate that the E.A.C. switchgear would comply with the requirements which would be called for in dealing with stations up to 40,000 kW.

I believe I am correct in stating that colliery engineers are fully aware of the type of switchgear which will be necessary to comply with rule 132.

A. W. Williams.

Nottingham.
December 17th, 1921.

High-pressure Fuses.

My attention has been directed to an article on "Fuses" by a "Central-Station Engineer," appearing in your issue of November 25th last, in which it is stated that auto switchgear is subject to trouble and liable to be blown up. Your contributor suggests, on account of the heavy cost thus entailed, the use of certain high-pressure fuses in place of the automatic tripping coils, or as a safeguard to protect the oil circuit breakers from damage on a short circuit occurring. He, however, appears to have overlooked a serious objection to the use of fuses for this purpose on a polyphase system. The fundamental difference between a fuse and a circuit breaker lies in the fact that a fuse will interrupt a multipole circuit as a rule in one pole only, whereas a circuit breaker under the same conditions will interrupt the circuit completely. This is of particular importance in the case of three-phase circuits feeding a number of motors when a single-phase interruption, either on the primary or secondary side, will subject all the motors on the affected circuit to the danger of excessive temperatures, and consequently to the possibility of defects in the armature winding. For this reason fuses for protecting such circuits are being given up.

There is no reason why oil circuit breakers should not give adequate protection without any damage under short-circuit conditions, provided they are of sufficient breaking capacity,

which there is no difficulty in guaranteeing when they are designed in accordance with the recommendations of the Swiss Association of Electrical Engineers, which are based on actual short-circuit tests by an independent committee.

The S and C fuses described in the article are apparently similar to those made by Messrs. Schweitzer & Conrad, of Chicago, which are filled with carbon tetrachloride, the disadvantage of which is the formation of certain fumes when the fuse blows, which oxidise and detrimentally affect the metal parts.

With a view of employing this liquid in place of oil-filling for high-pressure circuit breakers, official tests were carried out by the Swiss Association some years ago, the result of which proved that the advantages and disadvantages of oil against tetrachloride did not justify a departure from employing oil, and those undertakings which have employed tetrachloride have now returned to the use of oil.

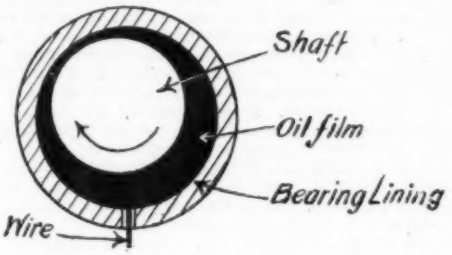
J. B. Rudkin.

London.
December 21st, 1921.

Worn-bearings Alarm Device.

I read with interest the brief details of the device, described under "New Electrical Devices, &c.," in your issue of December 16th, for giving warning of undue wear in bearings. The idea is undoubtedly ingenious, but it brings up several of the interesting problems which arise in connection with the lubrication of bearings.

It has been found by careful experiments carried out by Beauchamp Towers, Goodman, and others, that high-speed oil-lubricated journals assume a position, with respect to their bearings, somewhat as shown in the appended rough diagram. The arrow shows the direction of rotation, and the blacked-in portion the oil film (greatly exaggerated) surrounding the journal.



This film is actually thickest towards the bottom of the bearing, due to the feeding-down action of the rotating shaft carrying the oil round from the oil-ring grooves. The film of oil is at a very high pressure towards the bottom of the bearing. Naturally the above condition applies only to a rotating shaft.

It is evident that wear takes place during rotation, and, reasoning from this, we must conclude that the actual wear on the lining is caused by the high-pressure oil film. If the wire introduced at the bottom were of approximately the same degree of hardness as the lining, it is reasonable to suppose that the end of the wire would wear uniformly with the lining—thus keeping the film of oil between it and the journal. Hence it would appear that there is a possible cause for failure of the device here, on a high-speed journal running for very long non-stop periods, due to the insulating effect of the oil film. The thickness of the film varies, of course, but an average figure, that has been found by actual measurement, is round about 0.0005 in. This oil, at a very high pressure, would require a fairly high rupturing voltage.

It is easy to see that such a difficulty could be easily overcome by the use of a sufficiently high voltage or the use of a very hard material such as cast steel, for the introduced wire. The latter would probably prove more definite in action, though it would be bad for the journal.

Naturally the above trouble would not crop up with the bearings on a machine that was started and stopped frequently.

This is not intended as a criticism of the device, but merely to point out a difficulty that might occur under certain conditions.

E. R. Sanderson.

Bredbury.
December 20th, 1921.

[As mentioned in our note, the device can equally well be fixed outside the journal bearing, where there is no oil under pressure. We think there would be no risk of injury to the journal by using a hard wire, if it were found necessary, as the first contact would actuate the alarm.—Eds. Elec. Rev.]

Leaves from an Inspector's Note Book.

In reply to the letter from Mr. N. W. Walker, I hasten to state that with the exception of men like "Anode," I do not think engineer surveyors are fools. As a rule they are very tactful, nice engineers, but the few exceptions are, as I stated, bossy, conceited, and unlikeable individuals with opportunities. Of course, there are black sheep in every flock.

I did compare certain wealthy insurance companies to Hebrew money lenders, for at that time some of them were practically starving their inspectors. I am glad to note from Mr. Walker that since those days, owing to the efforts of the Engineer Surveyors' Association, they are obtaining more reasonable remuneration.

No plant under my care is insured against break-down. My Council employ engineers of their own and cannot afford such luxuries! So that my "throne"—as Mr. Walker calls it—has not lately been shaken by an inspector's report! Fifteen years ago, however (and before I knew what I know to-day), after I had foolishly recommended that the plant under my care be insured against break-down, an "Anode" type of inspector certainly did attempt to shake my "throne," so I reported him to my Committee, who promptly shook his "throne" by ending the insurance with his company, thereby, to my knowledge, saving the premium during the remaining four years I had the honour to serve them. No break-down took place in this time, nor were the engineers and myself disturbed by insurance inspectors with their everlasting foot-rules and written rules, and the borrowing of meggers! At that time a megger appeared to be the height of their ambition in the way of testing, but, of course, things have probably altered.

Again, no comment has ever been made about my balancer fuses being too heavy; as a matter of fact, my balancers have no fuses!

I have heard of motors being overloaded, but the motor which I gave as an example was (unfortunately for Mr. Walker's argument) connected to a blower. Mr. Walker will therefore see that it could not have been "badly overloaded," and guess again. Let insurance companies stick to inspecting and insuring plant against break-down which is in the hands of laymen and handymen—especially handymen. For an insurance inspector to come poking his nose into a power station, where even the shift engineers, and sometimes the switchboard men, are at least his equals, is silly, and I should say rather uncomfortable for the average inspector. Of course, "Anode" would probably give a lecture from the switchboard gallery about the mistakes the plant designers had made!

In conclusion, allow me to inform Mr. Walker that I have the honour to number amongst my friends at least one engineer-surveyor, and my previous letter was not directed against these gentlemen as a class. An ass is often unnoticed for quite a long while in many branches of engineering, but once let loose on society as an engineer-surveyor he cannot for long hide his light under a bushel.

A. J. Abraham.

Electricity Department,
Aberdare,
December 23rd, 1921.

With reference to Mr. A. J. Abraham's criticism on the above article by "Anode," it seems to me that Mr. Abraham is just a little too severe, and I give the opinion of quite an ordinary electrician. Having had dealings with electrical inspectors (both good and bad) and having read "Anode's" article, I cannot say that the article left me with the nasty taste complained of by Mr. Abraham. On the contrary, I think the article was humorous, and "Anode's" observations seemed to be quite true, judging by my own experiences in similar circumstances. Also, I do not think that "Anode" was posing as a judge over electrical engineers, but merely giving observations he had taken whilst on his daily rounds. He also states that he made a mistake in the connecting of a motor; in other words, he points out that he is not "infallible." Surely Mr. Abraham would not give instructions to any layman as to how to connect a motor or any other piece of electrical apparatus, and I fail to see where the "dirty trick" (as Mr. Abraham calls it) comes in. "Anode" (in my opinion) acted diplomatically when he sent the man for something whilst he ("Anode") changed the connections referred to. Had the man been an electrician and inadvertently made a mistake, it would have been an entirely different matter, but—a pork butcher!

In my opinion "Anode" is a young fellow, and I am inclined to think that Mr. Abraham has had trouble with one or two idiotic insurance inspectors, but he has applied the "cane" too hard on "Anode."

Contractor's Foreman.

December 17th, 1921.

A Disputed Meter Reading.

In reply to "Perplexed," I take it that the meter in question is of the mercury ampere-hour type. This meter will only register when current is passing through it. The case mentioned by "E.T.B." does not apply to a meter of this type.

"Perplexed" mentions having taken tests to earth, but does not say if he has tested "between." It is just possible that there may be a leakage between the wires without its showing as an "earth."

If the meter has a clock dial, *i.e.*, pointers, one of them may have slipped if improperly fixed. If it became so loose as to slip, it is scarcely possible that it would escape notice.

Another possible solution is that the meter had been read inaccurately on more than one occasion, and the mistake discovered and rectified on the June reading.

The test obtained on the meter is a very usual one for that type.

Cases similar to "Perplexed's" come up occasionally, and usually result in the consumer paying.

Every care is taken to provide a consumer with an accurate meter. It cannot work unless current flows through it, therefore I think the Corporation would be rather unwise not to charge for units registered.

Stop Watch.

December 22nd, 1921.

Switching Certificates.

I should like to obtain the views of your readers on the value of Messrs. A. P. Lundberg's switching certificates. In my search for employment I have met a large number of contractors who term them valueless. However, I should imagine that a wireman who possesses one or more certificates would be of more value to a contractor than the wireman who has no study about him. My employment-seeking travels have shown me that the average contractor is only conversant with simple controls, and thus cannot give his customers the true convenience of electric light. A good wireman is an asset, but the same man with a knowledge of variable controls, &c., is surely doubly so. I trust I am voicing the views of numerous other certificate holders.

Intermediate.

December 23rd, 1921.

Liquid Starters

In your journal of this week I notice remarks made at the discussion of Mr. Wilson's paper on the above subject, when it was asked why these starters could not be made so that the blades were always immersed in the liquid. This has been the practice of a well-known firm (Messrs. Allen West & Co.), and their starters have given entire satisfaction and comply with the Mining Regulations. I have also found liquid starters to be quite suitable for the control of main and tail haulage gears; such liquid starters should be rated in accordance with the duties placed upon them. Metallic resistances are apt to give trouble unless they are properly rated. It is no use condemning liquid starters because of the insufficient attention given to them by motor attendants.

C. Jones.

Chasetown,
December 19th, 1921.

BUSINESS NOTES.

Bankruptcy Proceedings. — Frederick Alfred Stanley Wormull, trading as Lewisham Electric Wiring Co., 273, High Street, Lewisham, electrical engineer. The following are creditors herein:—

	£		£
Aladdin Renew Lamp Co. ...	10	Southern Electric Co.	28
A. Garner	17	J. Watt	12
General Electric Co.	18	Mrs. Wormull	2,583
H. & J., Stevenson	1d		

George William Endall, trading as Endall & Co., Canal Motor Works, Canal Bridge, Church Street, St. Helens, Lancs, electrical, mechanical, and automatic engineer. The adjourned public examination of this debtor was held recently at Liverpool. The Deputy Official Receiver stated that the examination had been adjourned in order that the debtor might amend his statement of affairs. This had been done, and the examination was ordered to be closed.

B. Barnett, electrical engineer, 104, Whitechapel Road, E.1.—Receiving order made December 20th on creditor's petition. First meeting, January 6th; public examination, March 8th; both at Carey Street, W.C. 2.

A. J. Millcox, motor and electrical engineer, The Garage, Farnham Common, Bucks.—Receiving order made December 19th on debtor's own petition.

W. Hill, seedsman and electrician, Leigh, Lancs.—First meeting, January 4th, at the Official Receiver's offices, Byrom Street, Manchester; public examination, January 18th, at the Court House, Bolton.

T. D. Waring, electrical engineer and draper, 55, Walmgate, York.—Last day for proofs for dividend, January 11th. Trustee: D. S. Mackay, Official Receiver, Red House, Duncombe Place, York.

William Ashmore Bennett, electrical contractor, 1, Richardson Street, Derby.—At the Derby Bankruptcy Court, on December 20th, the public examination took place. The liabilities were £129, and there was a deficiency of £99. The business was commenced in October, 1919, with £200 of borrowed money, which had been paid back with 10 per cent. interest, and debtor had no receipts for the repayment of the £220. He attributed his failure to depression in trade, keen competition, and ill health. He said his profits did not reach more than £2 per week. The examination was closed.

John Glynn Williams, 4, Blaennant Street, Duffryn, Cymmer, Port Talbot, Glam., electrical engineer.—The first meeting of the creditors of the above was held recently at Swansea. According to the statement of affairs, the gross liabilities amounted to £4,433, of which £393 was expected to rank for dividend, against assets estimated to realise £11, or a deficiency of £382. The meeting was adjourned.

Company Liquidations.—The Ilford Dry Battery Co., Ltd., Wool Exchange, London, E.C.3.—The statutory meeting of the creditors of the above was held recently at the offices of the Liquidator, 2, Guildhall Chambers, E.C., when it was reported that the shareholders had passed the usual resolution for voluntary liquidation, and appointed Mr. G. W. Roberts, I.A., to act as liquidator. The statement of affairs presented by the liquidator showed liabilities totalling £1,977, made up as follows:—Unsecured creditors, £748; bank overdraft, £183; and debenture interest, £1,045. The assets were estimated to realise £713, from which had to be deducted £31 for preferential claims, leaving net assets of £682, or a deficiency of £1,294. The assets comprised stock, £319; fixtures and fittings, £61; German marks, £2 13s.; and book debts, £330. The statement also showed patents of the book value of £1,500. For the moment no value was placed upon these patents. It was stated that the company was originally interested in the manufacture of batteries under French patents, and in 1919 one of the patents was sold for about £2,000, and that money was utilised in discharging liabilities and wiping out a debenture. Since that date the company had traded in various goods, but had not succeeded in making a profit. It was pointed out that the assets shown in the statement of affairs were not sufficient to fully discharge the claims of the debenture holder, and there was nothing left for the unsecured creditors. After discussing the position a resolution was passed confirming the voluntary liquidation of the company with Mr. Roberts as the liquidator.

Automobile Electrical Repairers.—Winding up voluntarily. Liquidator, Mr. N. J. Dodd, Sardinia House, Kingsway, W.C.2. Meeting of creditors, January 5th at Sardinia House. Claims to the liquidator by February 5th.

Anglo-French Wireless Co., Ltd.—Winding up voluntarily. Meeting of creditors called for January 3rd at 10 and 12, Bishopsgate, E.C. Liquidator: Mr. S. Powell.

Wellman, Head, Stothert & Pitt, Ltd.—Meeting called for February 13th to hear an account of the winding up from the Liquidator, Mr. C. J. Barker.

Dissolution of Partnership.—E. Durden & Co., electrical engineers, 13, Queen Street, Liverpool.—Messrs. E. Durden, G. W. Thompson, and A. S. Allford have dissolved partnership. Messrs. Durden and Thompson will attend to debts.

Trade Announcements.—British Oxygen Co., Ltd., advise us that the registered office and works of the company are transferred, as from December 28th, to Angell Road, Upper Edmonton, N.18.

Messrs. H. G. Mabbs & Son have removed to Sussex Street, Lower Broughton, Manchester, and all communications should be sent there.

From January 1st Mr. A. Hinderlich (late Capt. R.G.A.) is taking over from the Photector Co., Ltd., the business of supplying wrought copper cable sockets and asbestos-woven resistance nets and grids hitherto carried on by it at Central Hall, Southall. Price lists of these manufactures have been received. He is also taking over the major portion of the premises, and the telephone number (Southall 121). He is relinquishing all other interests except the sale of instrument wires in small quantities for experimenters.

The Kartret Engineering Co., Ltd., has now removed to its new works at White Street, Southall, and all communications should be sent there.

Messrs. Engineering Supplies, Ltd., state that the new telephone number for their offices and warehouse at 155a, Upper Thames Street, E.C., is City 2299.

Messrs. Johnson & Phillips, Ltd., state that the telephone number of their new Liverpool branch (57, The Albany, Old Hall Street) is "Central 5145."

Catalogues and Lists.—Messrs. Simpson, Baker & Co., 4, St. Augustine's Place, Bristol.—Three illustrated and priced leaflets advertising pendants, bowls, and other lighting fittings. Also a blotter bearing a merry picture.

The "G. & P." Electrical Co., 29, Heathcote Street, Nottingham.—A leaflet giving prices of v.i.r. cable, ceiling roses, switches, &c.

Messrs. Ward & Goldstone, Ltd., Frederick Road (Pendleton), Manchester.—An illustrated and priced leaflet dealing with the "Facile" electric sealing machine. Also List W 100, giving prices of cables and flexibles.

MESSRS. CHARLES FER & Co., LTD., Rexine House, 42, Newgate Street, E.C. 1.—An illustrated leaflet giving particulars of the "Hecla" pedestal bowl fire.

ST. HELENS CABLE & RUBBER CO., LTD., Warrington.—A card giving in several illustrations a contrast between the "good old days" and the "good new days" brought in by St. Helens C.T.S. cable and band tires.

Private Arrangement.—GREEN, NUTTALL & Co., electrical engineers and contractors, 76, Victoria Street, Manchester.—The creditors of the above were called together last week, when a statement of affairs was presented, which disclosed total liabilities of £598, all of which was due to trade creditors. After allowing £25 for preferential claims, the assets were estimated to realise £135, or a deficiency of £463. It was reported that the business was commenced in March, 1921, with a capital of £150 found by Mr. H. Nuttall. In August Mr. A. Green came into the business, and from that date books of account had been kept. The present position was attributed to insufficient work due to lack of capital and the slump in trade. After a short discussion it was unanimously decided that the estate should be dealt with under a deed of assignment with Mr. Arthur T. Eaves, C.A., of Messrs. Harry L. Price & Co., 15, Fountain Street, Manchester, as trustee. The following are creditors:—

	£		£
City Electrical Co.	117	Falk, Stadelmann, Ltd. ...	29
R. S. Newton & Co.	75	Adams & Co.	26
General Electric Co., Ltd. ...	70	Arthur H Lewis	23
Hart Accumulator, Ltd. ...	54	A. & A. Electrical Co., Ltd. ...	18
Electrical Supplies, Ltd. ...	45	W. T. Rawcliffe, Ltd.	17
Higgin, Ltd.	41	Hough (W.) & Sons	14
		Driver, Drennan & Cooper ...	13

Calendars and Almanacs.—MESSRS. MATHER BROS., 36, Farringdon Street, London, E.C.4, have sent us a wall calendar with monthly sheets (each of which also has a complete calendar for 1922) mounted on stout card, and with a useful contrivance for bringing out the correct date "at a glance."

MESSRS. ROYCE, LTD., of Trafford Park, Manchester, have issued a calendar for 1922 consisting of monthly sheets, each carrying a picture of one of the company's electric cranes.

MESSRS. F. W. PARKES & Co., of 65, Dame Street, Dublin, have issued a wall calendar with monthly sheets for 1922.

From Mr. HARRY MOSS, 82, Leeds Road, Bradford, we have received a wall calendar with two-monthly sheets for 1922, each of the six sheets being humorously illustrated.

From the ALLIED NATIONAL CORPORATION, LTD., British agents for La Métallurgique Electrique (formerly Vedovelli, Priestley & Co.), we have received an ash-tray of wrought and polished marble, as a specimen of the products of their marble works.

Wages in the Electricity Supply Industry.—Under the agreement made in November, which provided for a reduction of wages by ½d. per hour for each fall of six points from the cost-of-living datum level of 120, wages are to be reduced by a further 1d. as from January 1st.

Unemployment.—The Ministry of Labour's statistics regarding the position on December 16th showed that the total number of unemployed fell during the week from 1,833,689 to 1,824,500. Short-time workers increased from 265,504 to 273,800. On December 9th, 107,638 men were employed on special relief schemes.

An Atlantic-Pacific Exhibition in 1925.—A Reuter message from Portland, Oregon, (U.S.A.) says that Portland has accomplished the first step in plans for the holding of a world's fair there in 1925—endorsement by the voters of a 2,000,000-dollar tax levy to be spread over three years—and attention is now directed to the second effort in the financing of the project, approval by the people of the State. This is a 3,000,000-dollar tax which, added to the amount Portland will raise and 1,000,000 dollars to be obtained by public subscription, will complete the financing. The fair, officially designated, as the Atlantic-Pacific Highways and Electrical Exposition, was projected to celebrate the completion of transcontinental highways, and the centenary of the invention of the electro-magnet.

Patents Applications.—Application has been made for the restoration of Patent No. 128316, of 1917, for improvements relating to electric batteries granted to George Nikolayevich Antonoff. Also for the restoration of Patent No. 93817, of 1915, for an improved method and apparatus for automatically compensating the expansion or contraction of wire, rods, or the like, granted to Walter Harrison Biddle.

Our American Contemporaries.—The American *Electrical Review* (Chicago) which was started about forty years ago, and has been on our exchange list as long as we can remember, has been sold by the *Electrical Review* Publishing Co., Inc., to the McGraw-Hill Co., Inc., and will be taken over by the purchaser on January 1st, 1922. The *Review* will continue to be published in Chicago, and will be issued monthly instead of weekly, as the *Electrical Review and Industrial Engineer*. The new proprietor describes it as an extension of the work of the *Electrical World*. Mr. C. W. Price, who has been at the helm of the *Review* for nearly forty years, issues his last word as editor in the December 31st issue.

For Sale.—By direction of the Disposal Board, MESSRS. BUCKELL, BALLARD & PENNINGTON will sell by auction in the Bicester Aerodrome, buildings and plant, including oil engines, dynamos, switchboard, &c.

MESSRS. HILLIER, PARKER, MAY & ROWDEN will sell by auction at the Grand Hotel, Bristol, on January 12th, factory premises with a total area of 42,000 ft., &c.

MESSRS. LEOPOLD FARMER & SONS will sell by auction early in January the metal plating and depositing plant and radiator tube machinery of Radiator Tubes, Ltd., of 114, Great Dover Street, S.E.

ASSETS AUCTIONS CO., LTD., will sell by auction on January 5th, at 119-121, Newington Causeway, S.E., electrical material and accessories, including motors, drillers, radiators, meters, fans, &c., also a quantity of wood blocks. (See our advertisement pages to-day.)

A Telephone Card.—The County of London Electric Supply Co., Ltd., has sent us a telephone card as in previous years. A picture gives an aeroplane view of London from the West, illuminated by an electric light—"the light for London."

Russian Electrical Undertakings.—According to an Exchange Telegraph dispatch from Berlin, the Soviet Foreign Trade Commissariat has published a first list of undertakings which are to be leased to foreign concessionaires. These include the Krivoi-Rog Smelting Works, the Nizhni-Dnieprovsk Engineering Works, all steel works and electrical stations of the Dniepner district, and the tramways of Kieff, Kharkoff, Ekaterinoslav, Elizabetgrad, Odessa, Krementchug, Orel, Winnitsa, and Nikolayeff.

According to the *Financial Times*, the dispatch states that the concessionaires will be obliged to undertake to restore production to a certain level. Of the output 10 per cent. will be put on the home market, 20 per cent. will be bought by the Foreign Trade Commissariat, 10 per cent. will be bought by the State for internal trade, and 5 per cent. will be reserved for the supply of Soviet landed properties. The State will take from 20 to 50 per cent. of the net profits. The concessionaires will be given security of tenure, but will have to undertake to feed their employés. The original owners of the undertakings will have a prior right to get concessions.

The Resources of Siberia.—In last week's *Manchester Guardian Commercial* appeared a report of an interview with Mr. A. G. Marshall, managing director of Becos Traders, Ltd. (formerly known as the British Engineering Co. of Russia and Siberia), which is a combination of some two hundred British engineering and allied firms associated for trade in Russia and Siberia. Mr. Marshall says that the resources of Siberia are so great and varied that there is hardly a metal or mineral which could not be produced. Development has been retarded by the lack of transport; the railways consist practically of the one main Trans-Siberian line. The Germans, before the war, recognised the possibilities of the country, and indications point to their desire to recommence operations as soon as possible. Eastern Siberia is largely under Japanese influence, but it is desirable to have international co-operation, so that the country came under no particular country's influence. The Russian Government is said to be anxious that British and other foreign firms should help to develop the resources of Siberia.

New Steel Works at Dowlais.—MESSRS. GUEST, KEEN AND NETTLEFOLDS, LTD., are putting down the foundations at the Dowlais Steel Works of new steel railway sleeper mills, which will replace, with the most modern equipment, the existing mills. The new auxiliary works and plant will be ready at the end of next year.—*The Times*.

Social Events.—To commemorate the making of 30,000 motors, Messrs. E. Brook, Ltd., of Huddersfield, invited their employés to a dance, which was held on Friday last at the Friendly and Trades Hall. In addition a small sum was handed to each employé, and a dinner, provided in the company's own canteen, was given to each. The dance lasted from 7.30 p.m. to 1 a.m. Messrs. J. Rattigan and W. McGaffie acted as M.C.'s. It is interesting to learn that Messrs. Brook report a decided turn for the better in trade. They attribute this to two reasons. First, that prices have been reduced to such an extent that electric motors can now be purchased at or about pre-war prices; and secondly, that with the establishing of cut-low prices, wholesale houses have been induced to place orders, and thus bring into being trade which had been dormant for some time.

B.T.H. Operatic Society.—Once again the Amateur Operatic Society of the British Thomson-Houston Co., Ltd., has gone to Gilbert and Sullivan, and, by permission of Mr. Rupert D'Oyley Carte, has produced "The Yeomen of the Guard," probably the most tuneful of all the celebrated group of operas. Performances were given at the Rugby "Hippodrome" from December 12th to 17th, and proved of great merit. This was the society's third show during 1921, and the sixth Gilbert and Sullivan opera performance—the "Mikado" having been given on two occasions.

The Swedish Telephone Fusion.—An extraordinary meeting of the L.M. Ericsson Telephone Manufacturing Co., held at Stockholm last week, accepted by an overwhelming majority the board's proposal for fusion with the H. T. Cedergren concern and an increase of the share capital.

Indian Telegraph Apparatus.—The workshops of the Indian telegraph service in Calcutta now rank as one of the principal undertakings in the city. The work undertaken includes the production of steel poles with fittings, masts, the supply of quantities of special furniture, a large proportion of the telegraph instruments used by the Department, telephone exchange switchboards, certain wireless requirements, and the maintenance of the postal fleet of forty motor lorries in Calcutta. The works also comprise a modern foundry capable of producing 200 tons of castings per month, and plant for making cables, steel tubes, nickel plating and galvanising. In the instrument branch, a system of apprenticeship has been introduced, which is expected to produce a body of workmen skilled in high-class work.

United States and Trade with Central America.—The organisation of a Central American Chamber of Commerce in the United States, which will work to maintain U.S.A. supremacy in trade with the Central American republics, is announced in connection with the Independence Centenary Celebration of the Central American States. The activities of the Chamber will be limited for the present to the Republics of Costa Rica, Guatemala, Honduras, and Nicaragua. Other countries will be included later. The United States now controls from 70 to 90 per cent. of the foreign trade of Central America, the announcement says, and the Chamber will devote its efforts to development of trade relations, so that this percentage can be maintained, or even increased.—*Reuter's Trade Service* (New York).

Trade with Rumania.—The recent decree of the Rumanian Government prohibiting all transactions on deposits held in that country by foreigners except under licence has naturally caused great perturbation in the minds of British exporters, and called a considerable amount of attention to the financial conditions of that country. The latest advices, however, point to the probability that this decree may not remain long in operation, at least in its present form. Detailed information on the finances of Rumania is contained in the "Report on Economic Conditions in Rumania, April, 1921," by the Commercial Secretary to H.M. Legation at Bucharest (Mr. Alexander Adams). Owing to the wide demand for this report it has been found necessary to issue a reprint, copies of which may be obtained through any bookseller, or direct from His Majesty's Stationery Office (price 2s. 11d. post free).

American Electrical Exports.—The Department of Commerce reports that American exports of electrical goods during October were considerably below the total for the corresponding month of 1920. Exports for October, by classes, together with figures for October, 1920, were as follows:—

Electrical Machinery and Appliances:—	October, 1920.	October, 1921.
	dollars.	
Batteries	483,109	211,758
Carbons	137,760	26,526
Dynamos and generators	970,840	779,330
Fans	55,212	15,444
Heating and cooking apparatus	182,715	74,302
Insulated wire and cables	575,041	177,536
Interior wiring supplies, fixtures, &c.	282,999	86,822
Lamps, arc	1,548	1,250
Lamps, incandescent—		
Carbon filament	16,871	3,980
Metal filament	354,536	104,889
Magnetos, spark plugs, &c.	317,891	140,068
Meters and measuring instruments	254,876	161,462
Motors	1,255,539	525,142
Rheostats and controllers	64,251	77,735
Switches and accessories	435,615	176,154
Telegraph apparatus, including wireless	24,751	42,769
Telephones	282,488	163,397
Transformers	785,300	464,281
All other	3,516,873	1,737,479
Total	9,988,215	4,970,332
Electric locomotives	17,450	236,845
Grand total	10,005,665	5,207,177

—*Reuter's Trade Service* (Washington).

E.D.A. Salesmanship Conferences.—At the second of these conferences, held on December 16th, Mr. J. W. Beauchamp spoke of the interest the meetings were arousing. He stated that in several districts in the provinces arrangements were being made for similar lectures to be given by bodies affiliated to the E.D.A.

It was also announced that the next London conference would be held on January 20th at the rooms of the Chartered Institute of Patent Agents, when Mr. W. A. Gillott would speak on "Salesmanship in Relation to Electric Heating and Cooking."

A New Hungarian Cable Factory.—It is reported from Budapest that the Pressburg Cable Works Co., and the Hungarian branch of the Vienna Bank Verein are in negotiation with regard to the establishment of a new cable factory in the vicinity of Budapest, for the production of cables, insulating tubes, and hard rubber articles.

Engineering Wages and Trade Depression in Australia.—The Clyde Engineering Works is dismissing 1,150 employés owing to the refusal of the Government to allow for the increased cost of constructing locomotives resulting from the increase in the basic wage.—*Reuter's* (Sydney).

Tokio Peace Exhibition.—The Department of Overseas Trade is in receipt of information from the Commercial Counsellor of H.M. Embassy in Tokio regarding the Peace Exhibition which is to be held there from March 10th to July 31st, 1922. It is thought that this exhibition may prove a good opportunity for showing new British goods, and it is recommended that British firms should make a small exhibit. It would appear that all the space available for foreign exhibits has been over-applied for. Messrs. Arthur Buckney & Co., of Tokio, have, however, secured a special site for the erection of a British pavilion, and intending exhibitors can obtain space therein on application to the London office of the firm at 40, Westminster Palace Gardens, Victoria Street, S.W.1. Rebates of freights on goods for exhibition have been arranged by Messrs. Buckney, ranging from 20 per cent. to 50 per cent., according to date of shipment.

Book Notices.—*Practical Electrician's Pocket Book and Diary for* 1922. London: S. Rentell & Co., Ltd. Price 3s. net.—The twenty-fourth edition of this useful little electrical guide has been further expanded by the addition of over 30 pages. Among the items appearing for the first time are chapters on the Tungar rectifier, electricity in motor vehicles, railway signalling, and current limiters. Other sections have been re-written in the light of later developments, and among these are the sections dealing with steam turbines, oil and petrol engines, mercury-vapour rectifiers, electricity in mines, and heating and cooking. As usual, references are made to works from which fuller information regarding the subjects dealt with may be obtained.

Universal Exchange and Interest Tables, by A. J. Lawson, M.Inst.C.E. Pp. 242. London: Thomas Skinner and Co. Price 15s. net.—These tables have been reproduced from "Foreign Trade Tables," by the same author, whose enthusiasm in undamped even by failing eyesight, largely due to his trying labours on these thousands of numerical expressions. The tables have been rearranged and amplified, and are based on the decimalisation of British money in terms of florins and cents, after the manner recommended by the Institute of Bankers and the Decimal Association; the first table gives the conversion equivalents, advancing by one farthing, for all amounts up to £1, and of course simultaneously gives the corresponding decimals of £1, the figures being identical. One wonders whether the many traders who are now using the decimalised pound in their catalogues and quotations for foreign business are aware that this is so. Next come interest tables at any rate from ¼ to 10 per cent. per annum, applicable to any capital sum; multipliers to reduce interest per annum to interest for any required number of days; and the same modified to take account of leap years. These tables are accompanied by explanatory notes and suggestions for shortening computations, and a table is given showing the number of days between any two dates in a year. Other tables relate to depreciation, exchange, the purchasing power of the sovereign abroad, and equivalent prices for British and metric weights and measures. The author gives the foreign rates *and their reciprocals*, pointing out the ease with which the latter can be used to convert British money into the equivalent value in any foreign currency. The rate tables run from 3.000 by steps of 0.005 up to 100.000, thus comprising about 4,800 items, in 40 pages, and the conversion tables for foreign currencies at par cover almost all countries and occupy 38 pages. For further details we must refer the reader to the book itself, which, we are sure, will more than fulfil the expectations that may be based on this brief review.

The Electrical Engineer's Diary and Year Book (534 pp. and diary). London: S. Davies & Co. Price 10s. 6d. net.

The fourteenth edition of this large, all-embracing work has been revised and brought up to date. A new section, dealing with "Trade Promotion," appears. This consists of 24 pages, giving directories of central station showrooms and electrical shop-window displays; notes on the preparation of tenders, the rating of electrical machinery, and conditions of sale of goods have been transferred from the "General Information" section. The last-named section has been somewhat curtailed, and we notice the omission of the "Trade Names" index, which, while occasionally useful, could not possibly be comprehensive enough to find room in a volume of this nature. In the "Electric Motor Control" section items on car switch control, rope control, and series control have been added. Other additions are notes on electric grills and large electric water heaters, and an index of vehicle battery charging stations in the British Isles. As usual the "Diary" is published in two forms, one with stiff covers and diary and the other with limp covers and the diary omitted.

"The Signal Service in the European War of 1914 to 1918 (France)," by R. E. Priestley. Chatham: The Secretary, the Institution of Royal Engineers and the Signals Association.

"The Henley Telegraph," Vol. I., No. 7, December. (40 pp.). London: W. T. Henley's Telegraph Works Co., Ltd. Price 6d. net.—This little magazine is up to its usual fine standard, and contains a number of interesting and amusing articles and notes.

"The Metropolitan-Vickers Gazette," Vol. VI, No. 104, November. Price 1s. post free.—This number describes the switchgear at the Jubilee Street station, Blackburn, and improvements at the Attercliffe Common Works. The special articles include "Limitations in the Design of d.c. Railway Motors," by E. A. Binney.

German Trade in Argentina.—Germans are making determined efforts to displace other foreign traders in the Argentine market. Eleven steamers have arrived at Buenos Aires from Germany within the last five weeks heavily laden with hardware, machinery, textiles, chemicals, and paper. Whereas steamers from other countries arrive partly loaded, those from Germany are full. The German factories are up to date with their deliveries on Argentine Government contracts, and they are having little difficulty in getting all the new Government business that is awarded on a competitive basis. The Krupp and Stinnes interests have just obtained each a half of a Government contract for 40,000 tons of rails, while the War Ministry is placing an order for tents, canvas and waterproof fabric in Germany to cost more than 22,000,000 marks. The Government last week awarded a German firm a contract for a steel bridge over the Riachola River at Buenos Aires. It will cost 310,000 gold pesos.—*Reuter's Trade Service* (Buenos Aires).

Price Guarantee.—Messrs. A. H. Hunt, Ltd., manufacturers of accessories for the motor trade, have circulated among their customers a price guarantee for 1922, under which they have guaranteed to maintain prices until November next. Their object is to inspire a greater degree of buying confidence. They mention under the heading of "exceptions" that "the removal of the Government Import duty in April next on genuine Hellesen dry batteries" is beyond their control, and must be an exception, "but the present list prices will remain the same."

LIGHTING AND POWER NOTES.

Accrington.—Electricity Scheme.—The Electricity Commissioners have sanctioned the borrowing of £15,000 for electricity extensions, provided an agreement can be arranged with the Blackburn Corporation with regard to the laying of a 33,000-volt cable between the generating stations of the two towns at an equal cost to each Council, for the purpose of reciprocal supplies. The Accrington Council has approved of these terms, and has arranged a conference with the Blackburn authority to link up the two towns.

Blackburn.—New Sub-station.—The new electric sub-station at Mill Hill was opened last week. The plant will receive power from the Jubilee Street distributing centre to produce extra-high-pressure energy for the district. Two of the largest mills in the vicinity are being equipped with electrical machinery.

Brackley.—Proposed Electricity Supply.—A committee has been formed to canvass the town with a view to ascertaining the probable number of consumers of electricity and likely supporters with capital. The proposal is to form a company to carry out a scheme at a cost of about £5,000.

Brentwood.—Application for Order.—The Brentwood District Electric Co. is applying to the Electricity Commissioners for a special Order for the supply of electricity to the district.

Cannock.—Loan.—The Urban District Council is applying to the Electricity Commissioners for sanction to the borrowing of £36,753, to cover the cost of erecting a new transformer station.

Chichester.—Sale of Undertaking.—The Corporation is applying to the Electricity Commissioners for a special order revoking the Chichester Electric Lighting Orders, 1898 and 1911, to annul the deed of transfer, and to authorise the Chichester Electric Light & Power Co., Ltd., to sell its electricity undertaking and works to the Corporation, and to authorise the Corporation to generate and supply electrical energy.

Christleton.—Electricity Supply.—Chester Town Council is canvassing the parish, with the object of ascertaining the probable number of consumers of electricity.

Colwyn Bay.—Wayleaves.—It was reported at a meeting of the Urban District Council that the new transformer station was practically completed and the underground main from the North Wales Power Co.'s Bronynant sub-station had been laid. The scheme has been delayed, however, by a dispute in connection with wayleaves, which has held up the erection of the overhead line from Dolgarrog to Bronynant. Representations are being made by the Council to the Electricity Commission.

Croydon.—Issue of Stock.—The Corporation is to issue stock to the value of £500,000. The funds so raised will be used, *inter alia*, for the provision of new sub-station buildings and plant, mains, switchgear, cooling towers, &c., expenditure which has received the sanction of the Electricity Commissioners.

Dartmoor.—New Hydro-electric Scheme.—It will be remembered that about a year ago a scheme to utilise the River Dart for the production of electricity was drawn up but abandoned on account of local opposition to what was called the "industrialisation" of Dartmoor. It is now stated that Sir W. G. Armstrong, Whitworth & Co. have projected another scheme which aims at developing about 10,000 water h.p. in two equal instalments. Reservoirs would be constructed on the higher waters of the East Dart and immediately below Dartmoor.

The whole of the scheme is said to involve an expenditure of about £500,000. The Devon County Council appears to be not unsympathetic to the project, but the Dartmoor Preservation Committee desires the submission of the scheme to it.

East Dean.—Electricity Scheme.—The Urban District Council has approved of a scheme proposed by Mr. W. T. Kerr, of Hereford, for the formation of a company to purchase the Beachley power station and to link up with the Hereford electricity undertaking, from which steps are being taken to supply Lydbrook with electricity in order to serve the collieries and Forest of Dean.

Edinburgh.—Price Increase.—The Electricity Committee recommends that the charge for electricity for power purposes be increased by ½d. to 2d., and the price of lighting energy by ½d. to 5d. per unit, the increased prices to take effect from January 1st.

Electricity District.—North Lancashire and South Cumberland.—The Electricity Commissioners give notice that they will hold a local inquiry at the Town Hall, Barrow-in-Furness, on January 31st, 1922, at 10.30 a.m., and following days, with reference to the area to be included in the above-named district and to consider a scheme which has been submitted by a Provisional Joint Committee for the establishment of a Joint Electricity Authority.

Harrogate.—Loan.—Application has been made to the Electricity Commissioners for sanction to the borrowing of £3,250 for mains extensions.

Hastings.—Mains Extensions.—The Town Council has adopted a report of the Electricity Committee recommending the laying of mains to St. Leonards, where the demand has exceeded the safe limit of the present mains. The estimated cost is £8,327.

High Wycombe.—Reduced Charges.—The Electric Light and Power Co., Ltd., has decided to reduce the price of electricity for power by 10 per cent., from January 1st.

Hull.—Extension of Supply.—At a meeting of the Corporation on December 15th, the engineer reported that the installation for the supply of electricity to Melton and Welton was practically completed. These extensions, which have cost about £85,000, transmit 2,000 kW at a pressure of 22,000 V, from the Corporation's power station to the two sub-stations, where the pressure is stepped down to 400 V. Two 1,500-kVA transformers installed at the power station bring the energy up to transmission pressure from the generated pressure of 6,600 V. The Corporation will sell about 9½ million kWh per annum through these extensions.

Horsham.—Year's Working.—The accounts of the municipal electricity undertaking (Engineer: Mr. F. Ffrench) for the year ended March 31st last, show a total revenue of £8,579, as against £7,675 in the preceding year. Working expenses amounted to £5,287, as compared with £4,891, leaving a gross surplus of £3,292 (£2,784). The net result was a profit of £374 as against £785 in 1919-20. The number of units sold rose from 273,952 to 313,531.

Keighley.—Supply to Skipton.—On December 20th the Corporation approved a recommendation of the Electricity Committee to apply for sanction to borrow £10,000 for the provision and installation of a transmission line from Eastburn to Skipton, together with the necessary control gear.

It was also decided to carry out, at a cost of £8,000, certain cable extensions, provided that assistance was forthcoming from the Unemployment Grants Committee.

Kettering.—Plant Extensions.—We have received from the electrical engineer (Mr. W. A. Walker, A.M.I.E.E.) an illlustrated brochure describing the plant recently installed at the municipal electricity works. This comprises a 1,500-kW set, consisting of a Parsons turbine, driving through double-helical, single-reduction gearing, a Mather & Platt alternator, generating at 500 V; a 30,000-lb. Stirling boiler with superheater and two Babcock & Wilcox chain-grate stokers; a cooling tower and tank, the tower cooling 175,000 gal. of water per hour from 100 to 80 deg. C.; a Weir turbine feed-pump capable of dealing with 5,000 gal. per hour; and switchgear made by Messrs. Ferguson & Pailin, Ltd., for controlling the generator and two feeders of 300 A and 600 A capacity. The total cost of the plant was approximately £40,000.

Leeds.—Proposed Price Reductions.—The City Council is recommended by the Electricity Committee to reduce the charges for electricity as from April 1st next. It is proposed that the present all-round increase of 80 per cent. upon pre-war prices shall be adjusted to 50 per cent. for power and 70 per cent. for energy used for other purposes.

Liverpool.—Proposed Amalgamation of Stations.—At a recent meeting of the Liverpool Tramways and Electric Power and Lighting Committee it was decided to recommend the City Council that the electricity undertaking of the Bootle Corporation, including the supply to the Urban District of Litherland, be amalgamated with the Liverpool electricity undertaking on terms and conditions set forth in a draft agreement between the two Corporations.

London.—ST. MARYLEBONE.—The Electric Supply Committee reports that the bulk supply demand of the Hampstead Borough Council has not exceeded 1,200 kVA; the agreement was for a maximum of 1,500 kVA. The present rate of charge is 30s. per kVA per half-year plus .7d. per unit, subject to slight variations. The Hampstead Council has been advised to close down its generating station and take a larger supply from an outside source. Terms have been arranged whereby the St. Marylebone Council will supply the needs of Hampstead. These terms involve the determination of the present agreement and the completion of a new agreement to provide for bulk supply for a period of 42 years from January 1st, 1922, subject to review at the close of every fifth year, the review at the end of the 35th year to suffice for the remaining seven years; the respective Councils to provide and lay at their own expense the necessary additional cables and apparatus within their own boroughs; the charges for electrical energy supplied to be as follows:—1.2d. per unit for the first million units per quarter, 1.1d. per unit for the second million, .9d. per unit for any quantity in excess of two million units, subject to adjustment according to variations in fuel costs and calorific values.

After satisfactory trial runs, the new 8,000-kW Oerlikon turbo-alternator is in commission, and the Fraser & Chalmers 8,000-kW set is well in hand, and will probably be running by the end of the year.

The Borough Council is carrying out experiments with the object of improving the lighting of Oxford Street and Regent Street. The Council has declined a company's offer to fix illuminated advertising signs to the street lamps in Oxford Street. A rental of £2,000 was offered, plus 2½ per cent. of the gross receipts obtained from letting the signs.—*Evening News.*

LONDON'S ELECTRICITY SUPPLY.—The Special Committee of the London County Council on Electricity Supply has written to the Electricity Commissioners to emphasise the importance of the conditions to be attached to the consent of the Commissioners to the erection of a power station at Barking, by the County of London Electric Supply Co. In the opinion of the Committee safeguards should be provided for the interests of the public, and to preserve the position of the Joint Authority or other purchasing body. No action should be taken that would tie the hands of the Joint Authority with regard to the future electricity development of the London area. On the other hand, the Commissioners should have regard to the possibility of no Joint Authority having been formed by the time the purchase powers expire, and make provision for some other authority to have alternative rights of purchase.

The Committee has communicated with the Prime Minister and the Ministry of Transport, urging that the passage of the Electricity (Supply) Bill, which was introduced in April, 1921, would conduce to the development of electricity supply, and tend to increase employment.

HAMMERSMITH.—The Electricity Committee proposes to organise a Development Department, in connection with the electricity supply undertaking, for the purpose of investigating new electrical devices and methods and giving consumers advice. It is proposed to hold an electrical exhibition in the Town Hall in the near future, and to erect a permanent showroom.

Lytham.—NEW PLANT.—A new engine and dynamo have been installed to meet the increased demand for electricity. The new engine of 900 h.p., coupled to a 500-kW generator, will bring the capacity of the electricity works up to 1,800 kW.

Rhuddlan.—ELECTRICITY EXTENSIONS.—The Council has under consideration a scheme for the supply of electricity to the towns and villages situated in the Vale of Clwyd. The estimated cost of laying cable in the area, which includes Ruthin, Denbigh, St. Asaph, and Rhuddlan, is £2,500 per mile, and the promoters are prepared to go on with the scheme provided the places named guarantee between them a consumption of 320,000 units per annum for a term of years, which the promoters state they could supply at 1½d. per unit. The Council has decided to send representatives to a conference of the local authorities concerned which is being called.

Rathmines (Co. Dublin).—PROPOSED LINKING-UP.—Negotiations are proceeding between the Rathmines and Pembroke Urban District Councils regarding proposals which have been made for the linking-up of the electricity stations of the two Councils. The estimated cost of linking-up is £50,000.

Rugeley.—ELECTRICITY SUPPLY.—The Development Committee of the Urban Council has recommended that information be sought from the Wolverhampton Electricity Committee as to whether it will supply the district with electricity.

Southampton.—EXTENSIONS.—At a recent meeting of the Borough Council a recommendation from the Electricity Committee to carry out extensions of distribution at a cost of £3,670 was approved. The Council referred back to committee a proposal to spend £1,000 in purchasing apparatus for a hire-purchase system.

Southend.—PROPOSED NEW PLANT.—The Electricity Committee reports that the electrical engineer has advised the installation of additional Diesel plant in order to meet the anticipated demand for the winter 1922-23; the accommodation available in the sub-stations and the main generating station will permit of such installation without it being necessary to incur the expense of erecting new buildings. The operating costs of the Diesel engine plant at the Leigh sub-station for the six months ended September last as compared with the cost of steam plant at the main generating station for the same period per unit generated, including interest and sinking fund charges, were 1.85d. for the former, as compared with 3.29d. for the latter, and in view of the comparatively low capital expenditure which would be incurred in installing low-speed Diesels, the committee favours the suggestion that this type should be installed in preference to steam plant, but before taking any action the reports are to be submitted to Mr. C. H. Wordingham, who has been retained to advise upon the present position and further extension of the undertaking.

Seaham Harbour.—PROPOSED ELECTRICITY SUPPLY.—A meeting of ratepayers, called by the Urban District Council, has approved, in principle, of an electricity supply for the town and district, and urged the Council to canvass all possible consumers with a view to the formulation of a scheme. The scheme at present suggested is to have a central distribution station to which power would be supplied from the mains of the Cleveland and Durham Electric Power Co. at 6,000 volts, and stepped down. The total estimated cost of the project is £16,670.

South Africa.—KRUGERSDORP.—The preliminary work in connection with the Krugersdorp electrical conversion scheme is now in hand. Prof. Buchanan and the engineers of the Victoria Falls Power Co. have arranged the route and the points of delivery of power.—*South African Mining and Engineering Journal.*

Ware.—ELECTRICITY SUPPLY.—At a recent meeting of the Urban Council, it was decided to approve the application of the North Metropolitan Electric Power Distribution Co., for an order to supply electricity in the Council's area.

Whitehaven.—PRICE REDUCTIONS.—The Borough Electrical Engineer (Mr. L. B. Hogarth, A.M.I.E.E.) informs us that the prices of electricity have been reduced as follows:—Lighting, from 7½d. to 7d. per unit; maximum demand, from 3½d. to 3¼d.; heating and cooking, from 1¾d. to 1½d.; power, from 2.05d. to 1¾d.; factory power, 60 per cent. increase reduced to 50 per cent.

Wolverhampton.—PROPOSED PRICE REDUCTIONS.—The Electricity Committee recommends to the consideration of the Corporation an early reduction in the price of electricity for lighting, power, and traction, and also in meter rents.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—ANNUAL REPORT.—In his report upon the working during the year ended March 31st last, the general manager of the Corporation tramways states that the net profit of £144 fell far short of estimates, and it was necessary to apply for permission to temporarily increase fares until February, 1923; this was granted. Referring to the apparently poor results of the first year of municipal working of the Fleetwood tramway, he says that due allowance must be made for the difference between municipal and company financial arrangements. Whereas the £10,704 earned would have provided an ample dividend to shareholders in a company, owing to the necessity for setting aside £21,000 for sinking fund and interest payments, the line showed a loss to the municipality. It is stated that accumulated arrears of renewal and construction work since 1914 will entail heavy charges during the next three years; the amount is estimated at £254,343.

A short statement of financial results was given in our issue of June 10th last (p. 753).

L.B. & S.C. Railway.—ELECTRIFICATION.—A Bill has been deposited in Parliament by the London, Brighton & South Coast Railway Co., in which powers are sought to raise funds by means of debenture stock for the electrifying of suburban lines.

Liverpool.—EXTENSIONS DEFERRED.—The *Manchester Guardian* states that because there was no quorum it was impossible to hold a meeting of the Liverpool City Council, which had been convened on December 21st, for the purpose of considering recommendations for extensions of the Corporation electric tramways. Twenty minutes after the hour at which the meeting should have been commenced there were present only 80 members, whereas 99 constitute a quorum. The Lord Mayor announced that, in the absence of a quorum, and the meeting being a statutory one, nothing could be done. It is understood that the effect will be to defer the scheme for at least twelve months.

South Africa.—RAILWAY ELECTRIFICATION.—Work has been commenced upon the electrification of the Pietermaritzburg-Glencoe line of the Government Railways. This is a most important section passing through the colliery district of Natal. Steep gradients are encountered by the line; in one part it

rises about 1,500 ft. in twelve miles and throughout the section there is little level running. Power will be provided by a generating station which is being erected at Glencoe.

Taunton.—ORDER CANCELLED.—The Ministry of Transport has informed the Town Council that an Order has been made abrogating as from December 6th the powers of the Taunton Electric Traction Co., Ltd., in respect of the tramways authorised by the Taunton Tramways Order, 1900, and the Taunton Tramways (Extension) Order, 1907.

TELEGRAPH AND TELEPHONE NOTES.

France.—TELEPHONE SERVICE.—That the Government's monopoly of the telephone service has been a failure is suggested by *The Times* in announcing a bold plan submitted by M. Deschamps, former Minister of Posts, Telegraphs, and Telephones, to industrialise the telephone. His idea is that the State should make over its monopoly to a company, which would take over not only the telephone system and apparatus, but also the *personnel* now employed by the State. The weak and impracticable side of his scheme is that the *personnel* should be "part-owned" and "part-paid" by the State. As against this proposal a Bill has been laid before the Chamber by the present Minister, M. Paul Laffont, which is an earnest attempt to remedy the defects of the existing system, while retaining the monopoly. Instead of yearly doles, M. Laffont asks for a lump credit of 1,600,000,000 fr. (£31,000,000), spread over a period of eight years. This would enable him to attain continuity in carrying out his plans. The financial programme counts on the voluntary assistance of the Chambers of Commerce, public and private establishments, municipalities, &c., in the shape of loans without interest. This last idea is already in operation at Lyons, Bordeaux, Lille, Roubaix, and other towns. M. Laffont proposes not only to speed up and improve the telephone service generally, but he means to modernise it in the technical sense of the word. Whereas the Parisian now pays 1,750 fr. (£35) annual subscription fee, M. Laffont intends to charge 350 fr. (£7) "*tout compris.*"

Imperial Wireless Chain.—The presentation to the Cabinet of the report of the Wireless Telegraphy Commission has afforded Dr. W. H. Eccles (vice-chairman) a suitable occasion to place before readers of *The Times* a broad statement covering the preparatory work that has been accomplished towards the improvement of Imperial communication. After referring to the unanimous report of the Wireless Telegraphy Committee that was published in June, 1920, Dr. Eccles points out, *inter alia*, that the establishment of intermediate relay stations shortened the average link of the chain to 2,320 statute miles. But even across 2,000 miles, especially in tropical regions, it would not be easy to guarantee an uninterrupted service, and when atmospheric conditions were unfavourable the most powerful of existing stations would often be asked to repeat messages. The Committee, therefore, had to find a method of generating electric waves which should be capable of adaptation at will to ranges varying from 2,000 to 11,000 miles, and capable of easy variation in strength from moderate to very intense, according to the atmospheric conditions. The most promising combination of flexibility and the other desirable qualities was found in the method utilising the thermionic valve, as yet untried on a large scale. In its report, the Committee recommended that the Imperial stations should be equipped with thermionic valve plant able to deliver at least 120 kilowatts of power to an efficient antenna and capable of extension to 240 kilowatts at a later date as desired. The principal stations in England, South Africa and India would communicate direct during the hours of each day known to be most favourable for the respective pairs of stations. When atmospheric disturbances at the receiving stations were slight, the messages might be in code or otherwise, and would be sent at high speed. When the atmospheric conditions were not quite suitable for coded and commercial messages, a considerable volume of news traffic could be conveyed. Later, when the atmospheric conditions became still more difficult, the intermediate relay stations would be called upon to take down messages for retransmission. The intermediate stations would doubtless have a certain volume of local traffic, and would be of strategical importance.

To plan the stations in detail the Wireless Telegraphy Commission was appointed by the Cabinet in December, 1920; its report has just been presented to the Cabinet, and is to be published shortly. In respect of thermionic valve plant, the Commission has drawn most of its practical and proved information from the staff of the Admiralty's station at Horsea, Portsmouth, and from the Marconi Co. Approximate estimates point to an average capital cost per station of not more than £160,000, including the transmitting and receiving sides of a duplex station, but exclusive of staff quarters, which may have to be provided at some of the sites.

After reference to the Press and propaganda aspects of the possibilities of an Imperial chain of wireless stations, Dr. Eccles concludes that the universal wireless progress during the eighteen months which have elapsed since the Imperial Wireless Telegraphy Committee formulated its scheme has tended to confirm its conclusions that an Empire wireless service can be made continuous and trustworthy at reasonable cost by the aid of intermediate relay stations, and that only in this way can we escape the partial and erratic service which must accompany attempts at direct communication across the immense distances separating the chief centres of the Empire.

Italy.—NEW WIRELESS STATION.—The Italian Ministry of Posts and Telegraphs is to grant a concession for the installation and working of a wireless station on the Island of Rhodes, to a private firm. The station is intended to establish a regular service of messages between Italy and Asia Minor.

Norway.—STORM DAMAGE.—A violent gale raged through Norway on December 17th. Great dislocation of the telegraph and telephone services was caused and communication with Denmark and Germany was broken. On December 20th communication was good with England, but the wires were overburdened. There was no connection with Germany, and with Denmark the connection was bad. Telegrams from Paris despatched on December 17th arrived by train from Copenhagen on the night of December 19th.—*Reuter's Trade Service* (Christiania).

Russian-Swedish Telegraph Service. — A complete official telegraph service between Sweden and Soviet Russia was established as from December 17th, a formal agreement having been concluded between the two countries based on the Swedish proposal regarding fees.—*Reuter's Trade Service* (Stockholm).

Wireless Telegraphy.—AMATEUR TESTS.—From midnight until 6 a.m. on December 8th, and at the same time on the following nine days, wireless amateurs of the U.S.A., organised by the Radio Relay League of America, attempted to communicate with amateurs in this country. A similar, but unsuccessful, attempt was made last February. This year, however, messages are said to have been accurately received from 43 amateur stations throughout the U.S.A. and Canada.

Mr. Paul F. Godley, who was sent over to this country by the American Radio Relay League, to act as official observer in the Transatlantic tests, selected Ardrossan, on the West Coast, as the most suitable site for a receiving station. Arrangements were made for messages to be sent each night, and Mr. Godley has been successful in receiving the messages. The most powerful station heard was that of an amateur at Toronto, and the most distant station that of an amateur at Atlanta, Georgia, 3,600 miles from Ardrossan. This is the first time that Transatlantic communication had been achieved with the low-power installations to which amateurs are restricted.

Wireless Telephony.—LONDON-AMSTERDAM CONVERSATIONS.—Speech by means of combined wire and wireless telephony was carried on between London and Amsterdam on December 18th, ordinary office telephones being used for the purpose. There is at present no direct trunk line communication between London and Amsterdam, and the demonstration, which took place at Marconi House, was made possible by means of a wireless link connecting trunk lines between the two countries. The General Post Office had placed the trunk line between London and Southwold at the disposal of the Marconi Co., which has erected a special wireless station at Southwold for the transmission across the sea. From Southwold the conversation was conveyed by wireless to Zandvoort, where another wireless station has been built. From there an ordinary trunk line conveyed the message to Amsterdam.

The circuits enabled conversation to be carried on in the ordinary way, one speaker breaking in and interrupting another as in ordinary conversation. This was achieved by working to Holland on a slightly different wave length to that used for the return conversation, and by separating the transmitting and receiving stations at either end. The wireless transmission was on an unusually short wave length, which is not in general use, and was relatively immune from atmospheric disturbance.

RAILWAY COMMUNICATION.—The hope that wireless telephony can be applied to avoid railway accidents is supported by experiments that have taken place between Paris and Creil, on the Nord Railway system. Wireless antennæ were fixed on a carriage, and one compartment was arranged as a receiving and transmitting post. Between two telegraph posts skirting the line another horizontal aerial was established at a given point, thus permitting the use by induction of the ordinary telegraph wires. The experiments, which began in November, were continued in December, and perfect results are said to have been obtained. From the time the train left Paris wireless conversation went on between the Gare du Nord and the special compartment of the train, and was kept up until Creil was reached. Experiments are to be attempted between Paris and Calais and on the Nord system.—*Daily Telegraph.*

MOBILE POLICE EQUIPMENT.—The Paris Prefect of Police is providing his force with motor-cars equipped with wireless telephone apparatus, from which it will be possible to telephone to headquarters or to one another. In police operations requiring great rapidity much time otherwise lost in using the ordinary public telephone offices will be saved and the

chances of success increased. The only point remaining to be settled is the wave length to be used, regarding which the Police Prefecture is now in communication with the Post and Telegraph authorities.—*Daily Mail.*

Wireless Telegraphy on Ships.—At the recent International Shipping Conference in London, a discussion took place on the regulations controlling the installation of wireless telegraph apparatus on board merchant vessels. It was argued that a free market for apparatus should be maintained, and that shipowners should have a free hand in dealing with the matter. An automatic alarm device should be sanctioned to avoid the necessity of human watchers for life-saving signals, and members of the crew should be trained sufficiently to be able to perform the duties involved, instead of carrying special wireless operators for the purpose. A committee is to be formed of representatives of shipowners to report upon desirable modifications of the Convention of London, and to secure their adoption by the Governments concerned.

Some details of the progress that has been made in the use of automatic devices for recording signals received from vessels in distress were recently given in *The Times*, according to which 25 vessels representing as many shipping companies are being equipped with the new "Four-second Alarm" of the Marconi Co. in order that it may be thoroughly tested in actual sea-going circumstances. The equipment of 10 of the ships is complete.

It is understood that whereas the North Foreland station will be fitted with the actual alarm, the Niton wireless station on the Isle of Wight will also co-operate by sending out experimental "Four-second" signals. The chief characteristic of the alarm is that it is wholly immune from interference due to general wireless communication and atmospheric disturbances, and unlike automatic devices intended to respond to the S.O.S. signals, it is not actuated by signal combinations having the same sequence as those appearing in S.O.S. With the present form of wireless distress signal (S.O.S.) there will probably be great difficulty in devising automatic apparatus for registering the receipt of the signal which will be sufficiently reliable to permit of its use on board ship in place of a watcher, as contemplated in section 9 of the Merchant Shipping (Wireless Telegraphy) Rules, 1920.

The distress signal cannot be altered without international agreement; but it has been suggested that, in order to avoid the difficulties resulting from jamming by atmospheric disturbances, the distress signal proper should be preceded by an "alarm signal" capable of actuating automatic apparatus without fail.

The alarm signal at present under consideration consists of a prolonged dash of four seconds followed by a space of one second, the alternation of dash and space being continued for one minute; and the automatic apparatus should respond to the alarm signal after the reception of any three consecutive dashes.

Copies of reports obtained at regular intervals from the masters of ships equipped with the device will be sent direct to the Secretary, General Post Office, for examination.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.)

OPEN.

Australia.—MELBOURNE.—February 1st. Victorian Government Railways. Four motor-driven grinding machines, with accessories.*

February 15th. 100 track relays; 50 line relays (cont. 34,739); 100 3-position line relays (cont. 34,740).* February 22nd. 100 electric signal mechanisms (cont. 34,738); electro-mechanical interlocking apparatus (cont. 34,822).* March 1st. 50 miles insulated copper wire (cont. 34,823).*

Bulgaria.—February 8th. Department of Posts, Telegraphs, and Telephones. 30 terminal boxes; 1,000 combined lightning arresters and 1-amp. fuses; 500 ditto, different type; 300 transformers; 700 condensers; 30 junction boxes.*

Chile.—February 4th. State Railways. Twelve windmills, complete; one electric compressor; one air-storage drum and d.c. motor; 1,300 metal-filament lamps for lighting locomotives; 38 wall telephones.*

East Ham.—January 12th. Electricity Department. One 1,500-kW converter, either rotary or motor type; e.h.p. and l.p. switchgear and connectors. (December 23rd.)

India.—MADRAS.—February 20th. Corporation. L.p. cables:—42 miles of twin 7/.044 S.W.G. and 13 miles of twin 7/.064 S.W.G. paper-insulated lead-covered and steel-tape armoured cables for 225-V, a.c. circuits. H.p. cables:—Two miles of 3-core 7/.044 S.W.G. and 5 miles of 3-core 7/.064 S.W.G. paper-insulated lead-covered and steel-tape armoured cables for 5,000-V, a.c. circuits with neutral point not earthed. Specifications and forms of tender (4s. per set) from the Publisher, ELECTRICAL REVIEW. (See this issue.)

Leeds.—January 12th. Electricity Department. Single-phase wattmeters for 12 months (minimum 2,000). (See this issue.)

London.—L.C.C.—January 12th. One electric passenger lift, capacity 11¼ cwt., with full automatic push-button control, to be completed within two months, at Geoffrey House, Tabard Garden Estate, Bermondsey, S.E. (December 16th.)

Maldens and Coombe.—January 10th. Urban District Council. Two 10-b.h.p. horizontal electric motors, starting gear, &c. Also electric lighting installation at Blakes Lane pumping station. Mr. R. H. Jeffes, engineer and surveyor, Municipal Offices, New Malden.

Manchester.—January 5th. Corporation. For Barton power station. Standard gauge railway, 2-way turntables (two of 20 tons and two of 40 tons capacity). Specifications, &c., from Mr. F. E. Hughes, secretary, Electricity Dept., Town Hall. Deposit £1 1s. (returnable).

New Zealand.—WELLINGTON.—January 17th. Post and Telegraph Department, 25,000 dry cells for telephone work.*

Peterborough.—January 12th. Electricity Department. One 3,000-kW turbo-alternator with condensing plant, two 750-kW rotary converters, two 100-kW motor generators, e.h.p. and l.p. switchgear, steam, water, and drain pipes, foundations for the above plant, and structural alterations to existing buildings. (December 16th).

South Africa.—JOHANNESBURG.—January 4th. Municipal Council. Two 2,000-kW converters, with switchgear and spares.*

PRETORIA.—February 1st. Public Works Department. Conduit and conduit fittings. Electrical Engineer, Public Works Department, Pretoria.

PORT ELIZABETH.—January 31st. Municipal Council. Tenders for electrical plant.*

DURBAN.—January 18th. 372 consumers' watt-hour meters, including 37 d.c. meters, 275 single-phase, 50-cycle induction type meters, and 60 3-phase, 50-cycle induction type a.c. meters for unbalanced leads.*

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Government Contracts.—The following Government contracts were placed during November, 1921:—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).

Accumulators.—London Battery and Cable Co., Ltd.
Cells and boxes.—Fuller's United Electric Works, Ltd.
Electric travelling blocks.—H. Morris, Ltd.
Electrically-driven capstans.—Sir W. Arrol & Co., Ltd.
Electric travelling crane.—H. Morris, Ltd.
Electric light and power cable systems.—Johnson & Phillips, Ltd.
Electric travellers.—Sir W. Arrol & Co., Ltd.
Electric hoists.—W. Wadsworth & Sons.
Electric cable.—Johnson & Phillips, Ltd.
Insulating materials.—Attwater & Sons; Connollys (Blackley), Ltd.; Ieco Rubber and Waterproofing Co., Ltd.; Mica Manufacturing Co., Ltd.; Micanite and Insulators, Ltd.
Motor and control gear.—Laurence, Scott & Co., Ltd.; English Electric Co., Ltd.
Rotary converter.—English Electric Co., Ltd.

WAR OFFICE.

Electric cables.—Enfield Ediswan Cable Works, Ltd.
Electric batteries.—C. A. Vandervell & Co., Ltd.
Electrical equipment.—A. Lyon & Co.; Parr Royal Engineering Works, Ltd.; Small Electric Motors, Ltd.
Electric fans.—General Electric Co., Ltd.
Electric generators.—G. Kent, Ltd.

AIR MINISTRY.

Electric storage battery.—Hart Accumulator, Ltd.; Chloride Electrical Storage Co., Ltd.
Booster pump.—Rees Roturbo Manufacturing Co., Ltd.
Magnetos.—British Thomson-Houston Co., Ltd
Wireless valves.—General Electric Co., Ltd.

POST OFFICE.

Testing, protective apparatus, &c.—Brit. L. M. Ericsson Manufacturing Co., Ltd.
Telegraph and telephone cable.—Enfield Ediswan Cable Works, Ltd.; Pirelli General Cable Works, Ltd.; Union Cable Co., Ltd.
Joint box castings.—United Steel Companies, Ltd. (T. Butlin & Co. branch).
Cords for telephones.—British Insulated & Helsby Cables, Ltd.; Siemens Bros. & Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Donington Sanitary Pipe & Firebrick Co., Ltd.; Doulton & Co., Ltd.; J. Oakes & Co., Ltd.
Laying conduits.—Stanningley, Stafford, Smethwick, King's Norton: Hodges Bros. (Contractors), Ltd.; Pontypridd, Shirley, and Selly Oak: Taplin & Holland, Ltd.; Colne, S. Jowett & Sons; Islington (Essex Road): W. Griffiths & Co., Ltd.; City of London, Sloane Ex. area and Nine Elms, S.W., Catton and Dereham, West Brompton, S.W., Tottenham (Lansdowne Road): J. Mowlem & Co., Ltd.; Wilmslow: E. Jowett; Stratford (Romford Road), Castleford, Preston-Blackburn-Burnley (Sections I., IV., & V.): J. A. Ewart, Ltd.; Harrow (Peterborough and Bessborough Roads), and Kensal Rise: G. J. Anderson; East Hoylake: Martin & Element, Ltd.; Newport-Pontypool: H. Smith; Low Moor (Bradford), Cleckheaton: Greig & Mathews; Frensham and Romsey: Hardy & Co.; Wrexham and Wrexham-Ruabon, Northwich, Newquay, Liskeard, Chalfont St. Giles, Hanley (Etruria Road), Crownhill): G. P. Trentham, Ltd.; Farnham Common (Bucks): G. E. Taylor & Co.; Aberdeen: R. Thorburn & Son; Colney Hatch Lane, Bath (Lansdown), Stepney, &c.: O. C. Summers; Bristol (Central South (Section II) and Queen Square): J. F. Hodge and Co.; Manchester (High Street) (Section III): W. Turner (Ardwick), Ltd.; Preston-Blackburn-Burnley (Section III.): R. & T. Howarth; Edinburgh (Newington): W. Dobson; Ashton-Hyde Junction, Farnworth (Lancs.), Kendal: W. Pollett & Co., Ltd.; Eastbourne: H. Farrow, Ltd.; Halesowen-Blackheath: A. Blair, Lyell and Co., Ltd.

Manufacture, supply, drawing-in, and jointing of cable.—London-Dorking (London district): W. T. Henley's Telegraph Works Co., Ltd.; Hampton Court-Staines-Egham-Ascot: W. T. Henley's Telegraph Works Co., Ltd.; Uxbridge, High Wycombe: W. T. Henley's Telegraph Works Co., Ltd.; Hawarden-Rhyl: British Insulated & Helsby Cables, Ltd..

Telephone exchange equipment.—Leeds: Siemens Bros. & Co., Ltd.; Aldershot: Siemens Bros. & Co., Ltd.; sub-contractors—Tudor Accumulator Co., Ltd., for batteries; English Electric Co., Ltd., for charging machines; Dunfermline: Peel-Conner Telephone Works, Ltd.; sub-contractors—Tudor Accumulator Co., Ltd., for batteries; Crompton & Co., Ltd., for charging machines; Broughty Ferry: Peel-Conner Telephone Works; sub-contractors—Chloride Electrical Storage Co., Ltd., for batteries; Crompton & Co., Ltd., for charging machines.

CROWN AGENTS FOR THE COLONIES.

Switchgear.—Ferguson, Pailin, Ltd.
Telegraph line material.—Bullers, Ltd.; Siemens Bros. & Co., Ltd.
Track circuiting material.—Westinghouse Brake & Saxby Signal Co., Ltd.
Transformers—Metropolitan-Vickers Electrical Export Co., Ltd.
Copper wire, &c.—British Insulated & Helsby Cables, Ltd.

HIGH COMMISSIONER FOR INDIA.

X-ray apparatus.—X-Rays, Ltd.
Cells.—Fuller's United Electric Works, Ltd.; Tudor Accumulator Co., Ltd.
Electric fans.—J. Stone & Co., Ltd.
Switchboard.—Erskine, Heap & Co., Ltd.
Copper wire.—Elliott's Metal Co., Ltd.
Wireless telegraph stores.—Marconi's Wireless Telegraph Co., Ltd.

H.M. OFFICE OF WORKS.

Electric lift.—Etchells, Congdon & Muir, Ltd.

London.—HAMMERSMITH.—Electricity Committee.

Additional feeder equipment, &c., for the bulk supply to Ealing Borough Council.

Two stonework cells, brass bars, and isolators, £335.—Ferguson, Pailin, Ltd. Recommended.

ST. MARYLEBONE.—Electric Supply Committee.—The Committee has received a claim from the Metropolitan-Vickers Electrical Co., Ltd., for £2,892, extras on account of the contract accepted on December 18th, 1919, for three 1,500-kW rotary-converters with transformers, starting and regulating switchgear, at £20,436, owing to increased cost of labour, materials and freight charges. After full consideration the Committee recommends that £2,000 be paid to the Metropolitan-Vickers Electrical Co., Ltd., in full settlement.

Paraguay.—According to the *Review of the River Plate* of November 25th, for the installation and working of a telephone system in the city of Asunción and district only one tender was presented—by Engineer Dowlin, who is stated to have the financial support of the International Western Electric Co., Incorporated. The firms of Siemens-Schuckert (Buenos Aires) and Ericsson (Stockholm), it is stated, abstained from presenting tenders owing to the very severe conditions imposed, and because materials were specified which neither of them manufactured.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, December 30th. At Caxton Hall, Westminster. At 8 p.m. Questions and general discussion.
Friday, January 6th. At 8 p.m. Lecturette, "Stone and Marble-working Machinery," by Mr. A. E. Bingham.

Royal Institution of Great Britain.—Christmas Lectures. "Electric Waves and Wireless Telephony," by Prof. J. A. Fleming, F.R.S. At Albemarle Street, W., at 3 p.m.
Lecture II.—Saturday, December 31st. Waves in Air.
III.—Tuesday, January 3rd. The Telephone.
IV.—Thursday, January 5th. Electric Oscillations.
IV.—Thursday, January 5th. Electric Oscillations.
V.—Saturday, January 7th. Electric Waves.

Nottingham Society of Engineers.—Wednesday, January 4th. At the Welbeck Hotel. Paper on "Modern Foundry Plant," by Mr. E. Stevenson.

Institute of Cost and Works Accountants.—Wednesday, January 4th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "Financial Planning," by Mr. H. G. Jenkins.

Physical Society of London and the Optical Society.—Annual Exhibition. Wednesday and Thursday, January 4th and 5th. At the Imperial College of Science, South Kensington. From 3 to 6 p.m. and from 7 to 10 p.m.
Wednesday, January 4th, at 4 p.m., and Thursday, January 5th, at 8 p.m. Lecture on "The Johnsen-Rahbek Electrostatic Telephone and its Predecessors," by Mr. A. A. Campbell Swinton, F.R.S.
Thursday, January 5th. At 8 p.m. Lecture on "Radium," by Mr. F. Harrison Glew.

Institution of Electrical Engineers.—Thursday, January 5th. At the Institution, Victoria Embankment. At 6 p.m. Paper on "Single and 3-phase Commutator Motors with Shunt and Series Characteristics," by Dr. S. P. Smith.

(Wireless Section).—Wednesday, January 4th. At the Institution, Victoria Embankment. At 6 p.m. Paper on "High-speed Wireless Telegraphy," by Lt.-Col. A. G. T. Cusins.

(East Midland Sub-Centre).—Tuesday, January 3rd. At the Loughborough College. At 6.45 p.m. Address by Mr. R. A. Chattock.

NOTES.

The Compliments of the Season.—The ELECTRICAL REVIEW wishes all of its readers "A Happy and Prosperous New Year."

A Height Recorder.—Apparatus for finding the height of the clouds for the information of night-flying airmen is to be tried at the London Air Station, Croydon. It consists of a 500,000 candle-power searchlight throwing a vertical beam upon the clouds, and a specially designed theodolite through which to observe the point where the beam touches the cloud. The angle obtained and the distance of the theodolite from the searchlight are all that the observer needs to find the height of the cloud.—*Daily Mail.*

Cost of Living in Cuba.—A correspondent seeks information as to the cost of living and generally any particulars regarding climate or other conditions which would have to be taken into account by a married Englishman in Cuba. If any reader could supply the required information we should be much obliged.

Service Notes.—A uniform for wireless operators of the Mercantile Marine has just been approved of and confirmed in the *London Gazette*. The uniform, or plain clothes, must be worn whether on ship, in port, or on shore, thus putting an end to semi-uniform. Warant Electrician E. D. Hines has been posted to Greenwich for duty. Captain J. R. Birch, A.M.Inst.C.E., London Electrical Engineers, has been transferred to the general list of the Reserve of Officers of the Territorial Army; Lieutenant A. W. Mawby, O.B.E., from the London Electrical Engineers, has been promoted major in the Territorial Reserve of Officers, and Lieutenant A.C. Stacey, from the London Electrical Engineers, has been transferred to the Territorial Reserve of Officers.

Appointments Vacant.—Assistant telegraph engineer (£450), for the Government of British Guiana Post and Telegraph Department; charge engineer, for Nelson Corporation Electricity Department; plumber-jointer, for Colne Electricity and Tramways Department; manager, for the Heywood Corporation electricity undertaking; telephone inspector (£350), for the Government of British Guiana; general clerk (£260), for the Hackney Borough Council electricity department; lectureship in electrical engineering (£550), for the Bradford Technical College; male clerk-typist (£3), for the Sevenoaks and District Electricity Co., Ltd. (See our advertisement pages to-day.)

A.E.G. Activities in Russia.—The *Manchester Guardian Commercial* quotes from the *Frankfurter Zeitung* a message from Riga relating to the activities of the A.E.G. in Russia: "The Soviet Government is now negotiating with the A.E.G. in Berlin with regard to the transfer of tramway concessions. The tramway systems in all the more important towns of Russia were previously in the hands of Belgians. The Soviet Government desires to reserve to itself 50 per cent. of the net profits, and it also stipulates that the company is to assume responsibility for the maintenance of its staff and workers."

This subject is also referred to in our "Business Notes" to-day.

Modern Conceptions of Corrosion.—In a paper on this subject read to the Liverpool Engineering Society, Mr. W. Ramsay, F.I.C., M.Inst.Met., points out that for the most part the term is confined to metals and alloys, although corrosion of non-metallic material is by no means uncommon. Such cases are, as a rule, simple chemical problems.

Again, it is necessary to discriminate between corrosion and erosion, or the loss of material by mechanical agencies, such as fluid or solid friction. Actually it is not always easy to distinguish between the two actions, which at times resemble each other very much, and may even proceed side by side in the same piece of metal.

Attempts to defeat or limit corrosion in metals must have been made at a very early date. Air and waterproof coatings find application under certain circumstances at the present time, but they are often applied to metal work in a very unintelligent manner. Metallic coatings are so well known that they require but brief comment. So-called "galvanising" is probably the best protective of this class, and zinc being strongly electro-positive to the iron, it remains effective even when part of the iron is exposed by wear or accident. The use of a more electro-positive metal, to provide a counter electro-motive force, sufficient to establish an electrolytic balance, is widely adopted in engineering practice, and zinc, being cheap and highly electro-positive to most engineering metals, finds a large application for this purpose. The efficiency of Hannay's "electrogene" was not very great, and it was abandoned. The idea that a relatively small area of zinc can prevent ionisation of a large area of less electro-positive metal is possibly correct in theory but fails in practice.

The first attempt to overcome corrosion by a counter electromotive force supplied from an outside source probably originated from Hannay. Boilers were fitted with plate anodes connected by insulated plugs through the shell of the boiler to the positive pole of an electric generator, the shell being connected up to the negative pole, the idea being to establish an electrolytic balance. Cumberland has improved the method by framing the anodes in such a manner that the current density is distributed more evenly over the whole interior of the boiler.

In conclusion, corrosion is to be regarded as a natural function of metals and alloys, and it appears to be established that it is always electrolytic in character. The few doubtful cases in which the action seems to be of the nature of a chemical solution require closer investigation, and in such cases there are features which indicate that the action is electrolytic though possibly obscured by other circumstances.

Transmitting Aerial Resistances.—The paper by Mr. T. L. Eckersley, B.A., B.Sc., that was read in December before the Wireless Section of the Institution of Electrical Engineers deals with the subject of the resistance of transmitting aerials. It describes an attempt which has been made to reduce to a minimum the energy losses in the neighbourhood of such aerials, which are known to be very inefficient, and shows that favourable results are obtained by interposing a screen of wires between the aerial and earth, using this screen as a counterpoise earth instead of the usual buried earth. The losses in such a system are analysed, and it is shown that a large fraction of the earth losses is eliminated when such a screen is used. Formulæ are devised for predetermining the resistance of screened aerials, in terms of the conductivity of the earth and the surface dielectric loss.

Such aerials have the drawback that the wires of the screen itself may form an oscillating system, and under certain conditions oscillations are set up in this system which waste energy. Methods of dealing with and eliminating these losses are discussed, and, finally, screening is compared with Alexanderson's multiple-earth system, and it is concluded that a combination of the two methods should give the best results.

The investigation has a very general bearing on wireless practice. We may, in fact, ask ourselves how far we may go on reducing the losses. The lines along which further reductions in earth loss may be effected are indicated by the theory, which shows that a simultaneous broadening of the screen and aerial has the desired effect. Again, the dielectric loss may be reduced by spacing the wires more closely or by using a complete radial screen in which the edge effect is reduced to a minimum.

Screens have been employed successfully at large power stations, and it now requires only one-sixth of the power to produce signals equal to those formerly produced by the spark station. It is evident, therefore, that the practice of long-distance wireless telegraphy may be very considerably modified by these results.

The practical point is this: It is much cheaper to erect an aerial of 400 ft., say, with 40 jars' capacity, than an 800-ft. aerial with 20 jars' capacity, and even cheaper still to use a 200-ft. aerial with 80 jars' capacity. The height rather than the area is the difficulty. If sufficient care is paid to the improvement of the resistance, the height of the aerial can be reduced without increasing the power required to produce a given range, and in the limiting case a closed directive aerial might be used to minimise jamming and to increase the effective radiation in the direction required, with a plate condenser which would effectively control the maximum voltage.

This condition of affairs is not possible when the dead-loss resistance is large compared with the radiation resistance for, when this is so, every decrease in height requires a commensurate increase in power. Although perfect radiation efficiency can never be obtained in practice, the reduction of the dead-loss resistance will always mean: (*a*) an economy in power required; (*b*) an economy in initial expense on aerials by enabling a lower aerial to do the work of a higher one.

In the case of certain existing aerials it is preferable to reduce the resistance by the Alexanderson method, especially in the case of long, narrow aerials. The screening of such an aerial may not reduce the resistance sufficiently, and it is a matter of great practical difficulty to widen an existing aerial and reduce the resistance in this way. The only alternative is to make use of Alexanderson feeders and to put the various sections of the aerial in parallel instead of in series, which is, in effect, equivalent to a simultaneous widening and shortening of the aerial. But to get the best results from this method a suitably designed screen should be used to intercept the lines of force from the aerial and to reduce, consequently, the surface dielectric loss.

The National Association of Supervising Electricians.—This Association, which was formed in 1914 primarily for educational purposes, lectures, &c., has made good progress, and has benefited not only its own members but also many electrical workers outside its ranks; whilst it was found necessary to register it as a trade union in order to enable it to protect the economic interests of its members, it has not relaxed its efforts towards education and efficiency, and by a strict scrutiny of the qualifications of candidates it has maintained a standard of membership which commands respect. As the result of negotiations with the employers, the Association has secured recognition, and an agreement between the National Federated Electrical Association and the N.A.S.E. was concluded in June last, which settled the status and privileges, working hours, holidays, &c., of staff foremen and supervising engineers respectively; this agreement remains in force until terminated by either side on giving three months' notice, to expire on February 28th in any year.

With a view to further development, the Association has now appointed Mr. A. Brammer as full-time general secretary, and steps are being taken to form district branches in Manchester, Birmingham, Middlesbrough and Portsmouth to begin with. In view of the difficult position of a foreman or supervisor who belongs to a manual workers' trade union, the need for such an association as the N.A.S.E. is obvious, and judging by its excellent record up to the present, it may look forward to a prosperous and useful future. Lecture meetings are held each month at St. Bride's Institute, Bride Lane, Ludgate Circus, the next being on Tuesday, January 10th; and the annual dinner will take place on January 28th. Other advantages of membership are the use of a technical library and the services of an employment bureau and a legal department. Particulars regarding membership can be obtained from the general secretary at the offices of the Association, 29, Metropolitan Buildings, 63, Queen Victoria Street, E.C.4.

The Electrification of Industry in the United States.—Mr. Fall, the secretary of the Department of the Interior, recently submitted to President Harding the analysis made by the Geological Survey of a comprehensive system for generating and distributing electricity to transportation lines and industries in the North Atlantic coast region, between Boston and Washington. The survey was authorised by Congress, and has been described in our columns.

The engineers who made the survey reported that 970 miles of 220,000-volt lines, and five times that mileage of 110,000-volt lines would be needed. The 1,200 miles of wire now carrying 33,000 volts and over would be operated as distribution lines for local industries. This transmission network with its sub-stations would require 104,000,000 dollars by 1930, the report said, in which year the total investment would be 1,109,564,000 dollars. Electrification of the Boston-Washington area, according to the report, would save 50,000,000 tons of coal annually by 1930, or 190,000,000 dollars in fuel expenditure.

The question of railroad electrification, continues the report, must be decided according to density of traffic, and so it is that, of the 36,000 miles of main line, yards, and sidings, in this super-power zone, only about 19,000 miles could be profitably electrified. This electrification would cost nearly 500,000,000 dollars, but it would save from 11 to 19 per cent. on the investment, or an average of 14 per cent. Electrification is the next step in railroad expansion absolutely necessary to increase both capacity and the efficiency of the transportation system. Incidentally, the annual saving of 9,000,000 tons of coal by the railroads would greatly increase the available car supply.—*Reuter's Trade Service* (Washington).

A Domestic Labour-saving Competition.—The Women's Engineering Society is organising a labour-saving competition divided into three sections:—(*a*) engineering devices suitable for mechanical, electrical, automobile work, &c.; (*b*) structural improvements; and (*c*) any other labour-saving appliance for the home. Full details may be obtained from the Secretary, 26, George Street, Hanover Square, W.1.

The competition will not be confined to members of the Society, all women are eligible to enter.

The contest should be productive of good results as only a woman intimately acquainted with the needs of the home can properly understand the business of lightening domestic labour. Mere man often fails to understand that "Woman's work is never done."

A Power Station's Future.—It is proposed to utilise the McDonald Road electric power station, Edinburgh, for an exhibition hall, when it is superseded by the completion of the Corporation electric power station at Portobello.

INSTITUTION NOTES.

Institution of Electrical Engineers.—EAST MIDLAND SUB-CENTRE.—A meeting will be held at The College, Loughborough, on January 3rd, and a paper will be read by Mr. R. A. Chattock on "The Electrical Development of Outlying Districts."

SCOTTISH CENTRE.—The annual dinner of the Scottish Centre of the Institution is to be held on February 28th, 1922.

Institute of Engineers (India).—The Institute of Engineers (India) has entered upon its second year, and is expected to become a very powerful body contributing greatly to engineering progress in that country. The Institute has local branches in Bengal, Bombay, Madras, and the United Provinces, while branches in the Native States, such as Mysore, will soon begin their activities. The membership is increasing rapidly.—*Reuter's Trade Service* (Bombay).

The Physical Society of London.—The Physical Society's and Optical Society's annual exhibition is to be held on January 4th and 5th, 1922 (not 5th and 6th, as stated last week), at the Imperial College of Science, South Kensington, and will be open in the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). Mr. A. A. Campbell Swinton, M.Inst.C.E., F.R.S., will lecture on "The Johnsen-Rahbek Electrostatic Telephone and its Predecessors" at 4 p.m. on January 4th, and at 8 p.m. on January 5th. Mr. F. Harrison Glew will lecture on "Radium: its Application in Peace and War," at 8 p.m. on January 4th. All the lectures will be illustrated with experiments. Other discourses are being arranged, over 50 firms are exhibiting scientific apparatus, and a number of experimental demonstrations have been arranged.

Chelmsford Engineering Society.—On December 16th Mr. E. A. Evans, of Messrs. C. C. Wakefield & Co., Ltd., gave an illustrated lecture on "Petroleum and its Lubricating Properties." After dealing briefly with the early history of petroleum, the development of oil wells, and the various refin-

ing processes, the lecturer gave a full account of the theory of lubrication and the latest discoveries regarding the molecular construction and properties of oils. The theory of lubrication based upon the molecular attraction of the oil and metal surface was discussed at some length. Although the radius of attraction of the molecule is only about 10^{-7} centimetres, yet it was shown how this force, operating over such a small radius, can be very great and is sufficiently great to maintain an oil film on the surface, and that the rupture force of the oil film is measured by the attractive force of the molecules. The dimensions of the molecules were also shown to be of value in lubrication problems.

Society of Engineers.—At the annual general meeting, held on December 12th, the following premiums for papers read during 1921 were awarded, amongst others: Bessemer premium (value £5 5s.) to Mr. R. W. A. Brewer, for his paper on "Some Modern Engineering Practice in America." Nursey premium (value £3 3s.) to Mr. Alfred S. E. Ackermann, for his paper on "The Physical Properties of Clay" (3rd paper).

Institution of Civil Engineers.—The Council of the Institution of Civil Engineers has made the following awards, among others, for papers printed without discussion in the *Proceedings* for the Sessions 1918-1919 and 1919-1920:—*Session* 1918-1919.—A Telford Medal to Professor E. G. Coker, F.R.S. (London); and a Telford Premium to Mr. Rollo Appleyard, O.B.E. (London). *Session* 1919-1920.—A Crampton Prize to Professor F. C. Lea, O.B.E. (Birmingham).

Greenock Association of Electrical Engineers.—At a meeting held on December 21st, Mr. R. F. McConnell read a paper on "Electric Cranes." Various modern types of cranes were illustrated by lantern slides, and prominence was given to rheostatic control systems and to the Scott-Bentley load discriminator. A keen discussion on brakes and limit switches followed the paper.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

In view of the prominence of Sir Vincent Raven in railway engineering, and the importance of the paper which he read recently before the North-East Coast Institution of Engineers and Shipbuilders (which is abstracted elsewhere in this issue,

Sir Vincent L. Raven.
Chief Mechanical Engineer to the North-Eastern Railway.

and on which we comment in our leading columns to-day), we have pleasure in reproducing his portrait as that of an engineer whose name will rank high amongst those of the pioneers of main-line railway electrification in this country.

Sir Vincent L. Raven, the son of the late Rev. Vincent Raven, Rector of Great Fransham, Norfolk, was a pupil under the late Mr. Fletcher, of the North-Eastern Railway, and after passing through various positions in the chief mechanical engineer's department of that railway company, including that of principal assistant to the chief mechanical engineer, was appointed head of that department on the resignation of Mr. Wilson Worsdell in 1910.

In August, 1915, Sir Vincent Raven (then Mr. Raven), at the request of Mr. Lloyd George, took charge as chief superintendent at Woolwich Arsenal, in the place of Sir Frederick Donaldson, which position he held until May, 1917. At that time the number of employés had risen to something over 73,000 hands, and an enormous output of every kind of war *matériel* was being delivered from the Arsenal.

He received a Knighthood in February, 1917, and was made a Knight of the British Empire in August, 1917.

In May, 1917, Sir Vincent was appointed by Sir Eric Geddes, then Controller at the Admiralty, as his deputy for the production of naval armaments, which included guns, mountings, shells, torpedoes, mines, &c., and also took charge of the torpedo factory at Greenock, the Gun Factory at West Houghton, the Cordite Factory at Holton Heath, and the Lighter-than-Air Section of Aircraft. This post he held until the end of 1918, and at the beginning of 1919 he resumed the position of chief mechanical engineer to the North-Eastern Railway Company.

Sir Vincent Raven is a member of the Institution of Civil Engineers, a vice-president of the Institution of Mechanical Engineers, and is also on the Advisory Committee to the Government for the Kensington Science and Art Museum; Sir Vincent was also on the Committee appointed by the Ministry of Transport under the chairmanship of Colonel Pringle, C.B., for the Revision of Railway Requirements.

Mr. W. E. Chappell, who has been connected with the Staveley Coal & Iron Co. and allied interests in the position of electrical engineer and consultant for the past 12 years, is severing his connection with the firm, as from December 31st, and is opening an office at St. Marie's Chambers, 6, Norfolk Row, Sheffield, as a consulting electrical engineer, specialising in the application of electricity to mining work.

The *Melbourne Age* reported on October 25th that the chief works manager of the Federal General Electric Co., Ltd., Melbourne (Mr. J. Durst), was leaving on a business visit to Europe and the United States. He is to inspect factories and plant with the view of obtaining the latest data for the company's equipment, and expects to return next March. The company was registered in Melbourne in September with an authorised capital of £750,000.

Obituary.—Mr. Jacob Atherton.—We regret to record the death, which occurred at Torquay on December 20th, of Mr. Jacob Atherton, of Huyton. Mr. Atherton, who was in his 69th year, had been in failing health for some months, and he went to Torquay in search of recovery. The *Liverpool Daily Post and Mercury*, in referring to the matter (Mr. Atherton being a native of Liverpool) gives the following particulars of the deceased gentleman's career: Mr. Atherton was associated with his elder and better-known brother, Mr. J. B. Atherton, in many important commercial development schemes. When his brother in 1890 returned from the United States with the patent rights in paper-insulated cables, Mr. Jacob Atherton joined him in the formation of the British Insulated Wire Co., and in the erection in 1890 of the extensive works at Prescot, which now bears the name of the British Insulated & Helsby Cables, Ltd., the business of the Helsby Cable Co. having been taken over more recently. The two brothers established a number of lighting concerns, including the Midland Power Co., the Blackheath and Greenwich Electric Light Co., and the South London Electric Supply Corporation, all of which Mr. Jacob Atherton was a director up to his death. From electric cables and power the two brothers turned their attention to tramways, and promoted in Parliament the Bill which authorised the laying down of the South Lancashire tramways system, which ultimately linked up Liverpool by tram track with Manchester. They also secured a Light Railway Order for a tramway between Aigburth and Garston, which paved the way for the extension of the municipal tramway service in the south end of the city. Mr. Jacob Atherton was associated with tramway construction schemes in Australia. Some thirty or forty years ago he purchased an extensive estate at Huyton, a portion of which has since been developed by the Huyton Golf Club.

Mr. John Milton.—We regret to record the death, after a short illness of Mr. John Milton, chief assistant engineer to the Wycombe (Borough) Electric Light & Power Co., Ltd., for over thirteen years. Mr. Milton was in his 43rd year. He served a pupilage with the Northampton Electric Supply Co., and after being on its staff as a test engineer, he became a shift engineer at Buxton, mains engineer and chief assistant engineer at Southend, and shift engineer at Battersea, which place he left to proceed to Wycombe in 1908. While Mr. W. E. Brandreth, the resident engineer and manager at High Wycombe, was on service in the Army, Mr. Milton, for four years, managed the station. He was an A.M.I.E.E.

Will.—The late Sir Douglas Fox left £45,766 gross and £44,988 net.

NEW COMPANIES REGISTERED.

Supra Electrical Co., Ltd. (178,452).—Private company. Registered December 16th. Capital, £2,000 in £1 shares. To carry on the business of mechanical, electrical, telephonic, gas, water, and sanitary engineers, electricians, gas and water fitters, &c. The subscribers (each with one share) are: L. H. Rochford, 63, Loveday Road, Ealing, W.13, engineer; Miss L. Rochford, Cedrus Lodge, Waltham Cross, Herts. The first directors are not named. Solicitors: Chamberlayne, Hocking & Co., 83, Pall Mall, S.W.

Carndonagh Electric Supply, Ltd.—Registered in Dubl'n, December 15th. Capital, £3,000 in £1 shares. To carry on business as electricians, mechanical engineers, and manufacturers of and dealers in electricity, motive power, and light. The subscribers are:—H. Doherty (junr.), Bridge Street, Carndonagh, builder, 200 shares; D. McCloskey, Chapel Street, Carndonagh, auctioneer, 25 shares; P. McLaughlin, Diamond, Carndonagh, provision merchant, 50 shares; P. J. Doherty, Carndonagh, draper and spirit merchant, 40 shares; G. Doherty, Carndonagh, spirit merchant, 50 shares; W. J. Crosson, Carndonagh, spirit merchant, 50 shares; R. Moore, Churchtown, Carndonagh, Clerk of Union, 50 shares; total, 465 shares. The first directors are:—H. Doherty (junr.), W. J. Crosson, R. Moore, J. Reid, and J. White. Secretary: J. Doherty (electrical engineer). Registered office: Bridge Street, Carndonagh.

British Engineering Units, Ltd. (178,516).—Private company. Registered December 20th. Capital, £1,000 in £1 shares. To carry on the business of mechanical and electrical engineers, manufacturers of and dealers in machinery, &c. The subscribers (each with one share) are: H. Megainey, 17, Shaftesbury Road, Earlsdon, Coventry, secretary; H. N. Gillitt, 15, Manor Road, Coventry, articled clerk. The first directors are: A. Green and S. A. Bailey. Solicitor: R. A. Rotherham & Co., 38, Bailey Lane, Coventry.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Western Electric Distributing Corporation, Ltd. (79,057). Return dated September 3rd, 1921. Capital at date of return, £43,000 in £1 shares (15,000 cum. preference, 3,000 preferred ordinary, and 25,000 ordinary). 12,790 cum. preference, 2,875 preferred ordinary, and 24,328 ordinary shares taken up. £39,428 paid. £565 remains in arrears. Mortgages and charges nil. Capital increased to £50,000 by the creation of a further 2,000 cum. preferred and 5,000 ordinary shares of £1 each.

Stentophone Motor Accessories (1921), Ltd.—Particulars of £25,000 debentures authorised December 5th, 1921. Whole amount issued. Charged on the company's undertaking and property, present and future, including uncalled capital.

Robert Bowran & Co., Ltd.—Satisfaction in full on December 7th, 1921, of mortgage dated May 1st, 1918, securing £2,000.

South-Western Engineering Co., Ltd.—A. W. Watts, of 364, Camden Road, N., as receiver, on December 9th, 1921, under powers contained in debenture dated September 9th, 1920.

CITY NOTES.

Cordova Light, Power & Traction Co., Ltd.

Sir G. A. Touche, Bart. (chairman), presiding over the annual general meeting on December 20th, said that although the company had been free from direct labour troubles, strikes at the port of Buenos Aires had held up supplies and greatly hindered maintenance work. The Provincial Government had sanctioned a large expenditure on raising and strengthening the San Roque Lake dam from which the company derived its water power, and had accepted a tender for the work. The Light & Power Co., through increased operating costs, had shown a loss of £2,007. The Tramways Co. had, however, shown improvements; the passengers carried had increased by nearly 3,000,000 and net receipts by £13,294. In conclusion, Sir G. A. Touche said that the working of the subsidiaries for the first six months of the current year showed an increase of £11,000 as compared with the first half of the year under review.

Vickers, Limited, Sheffield.

The annual general meeting was held on December 22nd at Sheffield. Mr. Douglas Vickers, M.P. (chairman), who presided, after dealing with the accounts of the company, spoke at some length about the subsidiary concerns. The item "Interests in Subsidiary and Connected Companies" showed an increase of about £840,000, partly due to a transfer from "marketable securities" of certain shares in Sir William Arrol & Co., Ltd., and the South Metropolitan Electric Light and Power Co., Ltd. The Metropolitan Carriage, Wagon, and Finance Co., Ltd., stood in the accounts as representing £12,954,000, being 99.9 per cent. of the capital of that company. Through the Carriage, Wagon, and Finance Co., Vickers, Ltd., held shares in Electrical Holdings, Ltd., and the Metropolitan-Vickers Electrical Co., Ltd., and through the Holdings Co. in Brown, Boveri et Cie. The company also owned about 99 per cent. of the capital of W. T. Glover & Co., Ltd., representing in the accounts £227,000. The whole of the ordinary shares of Wolseley Motors, Ltd., worth £700,000, were also held. Two companies formed to provide housing accommodation stood at £324,000 and £45,000. The company's interests in W. Beardmore & Co., Ltd., amounted to £484,500. They had also invested £114,000 in five syndicates formed for the development of hydro-electric concessions abroad, and their armament interests in Spain, Italy, and Japan amounted to £176,000, £84,000, and £343,000 respectively. The whole of the capital of James Booth & Co., Ltd., the manufacturers of "Duraiumin," was held by the company. Their interest in Vickers-Petters, Ltd., was of the value of £137,000. The total investments of the company were therefore about £17,389,000. In addition to this, Vickers, Ltd., held 85 per cent. of the ordinary shares of Canadian Vickers, Ltd. There was an uncertainty about the settlement of the company's claims on the Government in respect of contracts and taxation, but it was hoped that most of them would be agreed before many months had passed. Regarding the year just ending, Mr. Vickers said that the adverse influences mentioned in the report for 1920 continued into this year. The fall in shipping freights had embarrassed owners and reflected on ship construction. The price of coal remained at too high a level and exchange difficulties, the high cost of labour and low output had all had their effect, and nobody could expect the year's results to be good. As far as armaments were concerned, some relief had been evident through an order from the Japanese Government. The effects of the Washington Conference were still uncertain, but they would prove another justification of the policy which led the company to the acquisition of the Carriage, Wagon & Finance Co. The great engineering schemes of the future were certain to centre round electric power, traction and transportation, and in no other field did it seem possible to find work in this country for the steel works and engineering plants erected for war purposes.

Ferranti, Ltd.

The directors report a net profit for the year ended June 30th last amounting to £36,268, which compares with £36,622 for the preceding twelve months and £18,251 for the year to June 30th, 1919. Adding £89,461 brought in, the sum now available is £125,730. The *Manchester Daily Dispatch* states that it is proposed to transfer to general reserve £100,000, and to pay a dividend of 18 per cent., less tax (being three years' arrears) on the preference shares, leaving arrears of 54 per cent. A similar distribution was made for the two years ended June, 1920. With the above allocation the general reserve will amount to £172,000, and out of this it has been decided to write down the value of goodwill and patent rights, £69,370, to the nominal value of £1, leaving a balance in the reserve of £102,630. The submission of a definite scheme for the reorganisation of the company's capital has been postponed until conditions are more stable. Referring to the past year's results, the directors say that the trading has been satisfactory, but there has been a serious falling off in orders from the beginning of 1921, which will materially affect the results of the next financial year.

C. A. Vandervell & Co., Ltd.

Mr. C. A. Vandervell (chairman and joint managing director), presiding at the annual meeting on December 20th, said that the loss on the year's working was £251,280. The adverse result was due to the fact that although at the beginning of the year contracts to the value of £600,000 were in hand, these were practically all either suspended or cancelled. He admitted that, in the circumstances, the directors were wrong in declaring a dividend in December last, but it was thought that the serious depression could not last very long. It was anticipated that a percentage of the bad debts, for which a very large sum had been reserved, would be recovered in the future. Among the activities of the firm during the year had been the acquisition of the patent rights of the Willard rubber separator for accumulators (in the chairman's own name); the concentration of the dynamo and electrical business in the Warple Way works (which effected great economy in overhead charges); and the manufacture of the Aveline aeroplane stabiliser.

Mr. F. L. WADE, O.B.E. (joint managing director), seconded the chairman's motion, and said that since the end of the year under review the position had improved considerably. Liabilities had been met and trade creditors reduced by nearly £100,000. In spite of the continued depression, the business was on a solid foundation.

The Société Industrielle des Téléphones.

The report of the directors of this French company states that only certain of the manufacturing departments suffered in the second half of the financial year 1920-21 from the commercial and industrial crisis. On the other hand, the other departments derived benefit from a large volume of orders which had not been executed by the end of June, 1920. The company partially completed the installation of its works in Paris, Bezons, and Levallois out of its own resources. The profits realised in 1920-21 were considerably greater at 7,014,000 fr. than in the previous year. An addition of 1,750,000 fr. was made to the contingency fund, which was thereby increased to 7,000,000 fr. This fund would permit of the company's continuing its programme without, for the present, having recourse to the augmentation in the share capital which was authorised in September, 1920. At the recent meeting a dividend at the rate of 40 fr. per share, less tax, was approved, and the sum of 37,000 fr. carried forward. As to the question of the suggested leasing of the French telephone service to a company, the chairman stated, in reply to questions, that he was very sceptical on the matter, and that

it was necessary to await the conclusions of the discussions which were to take place in the Chamber on the subject. The matter, however, was of little importance to the company, which was a manufacturing undertaking, and it was necessary to be very diligent to have a full order book.

Barbados Electric Supply Corporation, Ltd.

The trading profit for the year ended June, 1921, amounted to £5,272, as compared with £4,618 for the previous year, and £3,600 for 1919. After charging general expenditure in London, debenture and loan interest and Corporation Profits Tax, the total amount remaining at the credit of profit and loss account (including £2,767 brought forward) is £6,084. Of this amount £5,000 has been transferred to depreciation reserve account, leaving £1,084 to carry forward. £1,481 has been charged against trading for repairs and renewals as compared with £1,128 in the previous year. Capital expenditure during the year amounted to £7,657, consisting of further payments made on account of the new 225-kW set referred to in the last report and the cost of additional house connections and mains.

	Consumers connected at June 30th	25 c.p. equivalent connected at June 30th.
1919	1,646	23,034
1920	1,783	23,903
1921	2,087	25,796

Colonel Leese visited Barbados during the year, and his report will be of great value in dealing with the future development of the undertaking. Meeting: London, December 30th.

German Companies.

The *Vogel A.G.*, of Berlin, makers of insulated electrical conductors, proposes to pay a dividend and bonus at the rate of 35 per cent. for 1920-21, being the same as in the preceding year. It is now proposed to increase the share capital from 26,000,000 to 52,000,000 marks.

The directors of the *Poege Elektrizitats A.G.*, of Chemnitz, recommend a dividend at the rate of 12 per cent. for 1920-21, against 17 per cent. in the preceding year on a smaller share capital. It is intended to raise the share capital from 46,000,000 to 56,000,000 marks.

The *A.G. fur Elektrizitats Anlagen*, of Berlin, which is an investment company, records net profits and balance forward of 850,000 marks for 1920-21, as contrasted with 650,000 marks in the preceding year. The rate of dividend rises from 6 per cent. in 1919-20 to 8 per cent. last year.

The *Elektrische Licht und Kraftanlagen A.G.*, of Berlin, reports gross receipts amounting to 21,800,000 marks from interest charges and investments, as compared with 93,000,000 marks in 1919-20. Including the balance forward, the net profits in 1920-21 were 9,998,000 marks, as against 3,645,000 marks, and the dividend is at the rate of 15 per cent., or 5 per cent. higher than in 1919-20.

The *Rheinische Elektrizitats Gesellschaft A.G.*, of Mannheim, reports net profits and balance forward amounting to 4,607,000 marks for 1920-21, as compared with 2,031,000 marks in the preceding year. It is intended to pay a dividend at the rate of 15 per cent., as against 10 per cent., and to make a fresh issue of ordinary shares to the amount of 18,000,000 marks.

At the general meeting of the A.E.G., held at Berlin on December 20th, a dividend of 16 per cent., as against 14 per cent. last year, was declared on the ordinary shares of the company. The capital of the company has been increased by 250,000,000 marks to 1,100,000,000 marks.

Stock Exchange Notices.—Dealings in the following securities have been specially allowed by the Stock Exchange Committee under Rule 148a:—

Llanelly and District Electric Lighting and Traction.—£125,000 seven-and-a-half per cent. debenture stock, issued at 94 per cent., partly and fully paid.

Reading Electric Supply.—£100,000 seven-and-a-half per cent. first mortgage debenture stock, issued at 95 per cent., partly and fully paid.

Metropolitan Electric Supply.—£178,400 5 per cent. extension debentures, 1917, within Nos. 1 to 2 500 (£100).

Telephone Manufacturing Co. (1920).—£300,000 guaranteed 8 per cent. cumulative income bonds (registered), issued at 96 per cent., partly and fully paid, in bonds of £10, £50 and £100.

The undermentioned have been ordered to be officially quoted:—

General Electric Co.—£3,500,000 seven per cent. mortgage debenture stock.

Applications have been made to the Committee to allow the following to be officially quoted:—

Monterey Railway, Light and Power.—$2,996,562 five per cent. "A" first mortgage debenture stock; $2,996,562 five per cent. "B" cumulative income charge debenture stock; and $2,674,962 "C" sinking fund debenture stock.

Guanajuato Power & Electric Co.—The bondholders of the Guanajuato Power & Electric Co., the Michoacan Power Co., and the Central Mexico Light & Power Co., have been notified of the proposed payment on January 1st, 1922, of the first coupon in default upon the bonds of each of the three companies.—*Financial Times.*

Provincial Cinematograph Theatres, Ltd.—The trading results for the year to date, says *The Times*, do not justify the payment of the dividend for the last half of the year on the 10 per cent. cumulative preferred ordinary shares.

Alldays & Onions, Ltd.—According to the *Financial Times*, the accounts for the year to July 31st, 1921, show a loss, including interest on debentures, of £108,303. The greater part of the loss consists of depreciated value of stocks owing to fall in prices. The company also suffered considerably from the miners' strike. Deducting £5,248 brought forward, there remains a deficit of £103,055.

Reduction of Capital.—Fuller's United Electric Works, Ltd., and Reduced.—A petition for confirming the proposed reduction of the capital from £500,000 to £378,794 has been presented to the High Court, Chancery Division, and will be heard in London by Mr. Justice Russell on January 17th.

Crompton & Co., Ltd.—Interim dividend at the rate of 7 per cent. per annum on the preference shares for the six months ended September 30th, 1921.

Vulcanite, Ltd.—Dividends on the ordinary shares of 7½ per cent. for the year, less tax, carrying forward £7,555.

Shawinigan Water & Power Co.—Dividend of 1¾ per cent. on common stock for quarter ending December 31st.

STOCKS AND SHARES.

Wednesday Morning.

The week which intervenes between Christmas Day and New Year's Eve is not usually a busy one for the Stock Exchange. It brings a good many orders of the "clearing-up" type; some people want to sell in order to increase their bank balances, others like to round-off uneven holdings by the purchase of more stock before making-up their accounts for the year. New issues loom large in the immediate future, and this induces a waiting policy on the part of prospective investors. There are other reasons for financial lassitude this week, but those just cited are sufficiently potent to exercise a restraining influence upon Stock Exchange business, and therefore to make for small fluctuations in price-lists.

Several of the newly-issued debentures are distinctly better. Reading Electric 7½ per cent. debenture, offered at 95, has jumped to 3¼ premium. Llanelly & District Electric Lighting debenture stock, which came out at 94, went to 10s. discount at first, but promptly rose to 15s. premium. Midland Counties 7½ per cent. debenture, at 96¾, is 15s. above the issue-price. All these three have the advantage of being obtainable in "scrip" shape, thus saving the buyer from the expense of the Government stamp-duty which is one per cent. upon registered stock. The Newcastle-on-Tyne 6 per cent. second debenture remains at a small premium above the price at which it was offered, 95½, and can also be bought free of stamp-duty.

Shropshire, Worcestershire, & Staffordshire 7½ per cent. debenture stock has taken a sharp turn for the better, and is up to 102, with very little stock offering. This particular issue took rather longer than usual to get permanently placed, but it would seem to be very well held now, and there are more buyers than sellers. British Thomson-Houston 7 per cent. mortgage debenture advanced to 2 premium, at which price stock came to market, and the price slipped back a little. There is still a small amount of Anglo-Argentine Tramways 5 per cent. debenture stock in the market at 64 ex-dividend; the yield at this price is a trifle over 7¾ per cent. on the money. Both classes of the company's preference shares are better on the week, and, with Argentine Rails also commanding better figures, the prospect of a steady advance to 70 in Anglo-Argentine 5 per cent. debenture should not be overlooked when investment stocks are under discussion.

County of London 7 per cent. debenture is firm at 104, English Electric 8 per cent. notes are on offer at 99¾ cumulative dividend, and General Electric 7 per cent debenture remains a good market at 98. A thousand or so of the company's 6½ per cent "A" preference, recently on offer at 17s. 6d., have been taken. Clyde Valley Electrical second preference shares, of £10 each, are a shade better at 3/16 premium.

Charing Cross ordinary, and Kensington ordinary are each 9s. 6d. higher, the approach of dividend-time serving to quicken interest in electricity supply shares. It is expected that the companies will be able to report lower working-costs in respect of the current six months, with the anticipation of further reductions in the near future. South Londons had a sudden spurt to 2¾ bid, with buyers ready to pay more if they could obtain the offer of shares. Curiosity promptly arose as to the possible reason for this pressing demand.

The manufacturing group is practically unchanged. British Aluminiums are sixpence harder. The Telegraph manufacturing list is equally quiet, and there are no changes to record on the week.

Marconis at 33s. 9d. soon lost the improvement scored on the declaration of the 5 per cent. interim dividend. Canadian Marconis have weakened to 4s. 6d. On the other hand, Radio Corporations firmed up to 10s., the preferred keeping

at 9s. 3d. United River Plate Telephones at 5⅞ are nominally 3/16 higher. Actually they are not much better than they were a week ago: it may be that a previous advance was overlooked. Eastern Telegraph ordinary has gained 2¼, and rises are shown by Eastern Extensions, Westerns & Globe preference. These recoveries underline the recent surmise that the heaviness apparent in the market earlier this month was due to causes other than any apprehension of wireless systems "cutting-out" the submarine cables, as some are fond of arguing will be the case. Experience has demonstrated that there is plenty of scope and plenty of business for both.

The boomlet in Underground Railway stocks suffered a check on profit-taking in advance of the Christmas holidays. Underground income bonds, having put on ten points in the previous fortnight, cannot be called flat on a reaction of 1½. Districts are unchanged at 21; Central Londons maintain their Strength, and Metropolitan Consolidated at 26½ is the fraction better. All the prior-charge stocks in this list are up from one to three points, the preferences showing particular strength. Indeed, the market has been swept almost bare of the pre-ordinary issues by the remarkable revival of demand for such securities.

Brazilian Traction are 2 down at 31. Mexican Utilities are without alteration. British Columbia preferred is 1 up. Reference has been already made to the rises in Anglo-Argentine Tramways first and second preference shares. The rubber share market is passive, although rubber itself exhibits a faint, a very faint, tendency to harden. Armament shares are steadier without attracting any particular business. The Vickers meeting produced a mild protest from some of the ordinary shareholders disappointed at the results achieved last year. Babcock & Wilcox, with other engineering descriptions, maintain their ground.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1919.	Dividend. 1920.	Price Dec. 23, 1921.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	12	12	6½	—	£9 4 8
Charing Cross Ordinary	7	8	4½	+ ⅛	8 13 2
do. do. do. 4½ Pref.	4½	4½	3¾	—	7 4 4
Chelsea	4	6	3½	—	9 4 8
City of London	13	14	1-/-	—	9 14 10
do. do. 6 per cent. Pref.	6	6	12/-	—	6 18 4
County of London	8	8	8½	—	9 2 10
do. do. 5 per cent. Pref.	6	6	7¼	—	7 10 0
Kensington Ordinary	7	9	5¼	+ ⅛	8 16 6
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	8½	—	9 12 0
Metropolitan	6	7	8¾	—	9 6 8
do. 4½ per cent. Pref.	4½	4½	2½	—	7 18 2
St. James' and Pall Mall	12	12	6¾	—	8 17 10
South London	6	7	2¼	+ ¼	10 9·0
South Metropolitan Pref.	7	7	17/6	—	8 0 0
Westminster Ordinary	10	10	5¼	—	8 10 2
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	84½	+ ½	7 2 4
do. Def.	1½	1½	18½	—	8 2 2
Chile Telephone	6	6	5½	—	5 17 8
Cuba Sub. Ord.	7	7	7	—	10 0 0
Eastern Extension	10	10	16½	+ ¼	6 1 2
Eastern Tel. Ord.	10	10	166	+2½	6 1 0
Globe Tel. and T. Ord.	10	10	16½xd	+ ¼	6 3 1
do. do. Pref.	6	6	9¼	+ ¼	6 6 6
Great Northern Tel.	22	24	26½	+ ½	9 0 6
Indo-European	10	10	27½	—	9 2 0
Marconi	25	15	1⅞	— 1/16	8 13 0
Oriental Telephone Ord.	12	12	2	—	*6 0 0
United R. Plate Tel.	8	8	5⅞	+ 1/16	*6 16 2
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	16½	+ ½	*6 1 2
HOME RAILS.					
Central London Ord. Assented	4	4	51½	—	7 15 4
Metropolitan	1½	1½	26½	+1	5 16 3
do. District	Nil	Nil	21	—	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	4	2	76	—1½	*8 19 0
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	2 13/16	+ 1/16	10 7 6
do. do. 2nd Pref.	Nil	6½	2 13/16	+ 1/16	7 17 3
do. do. 5 per cent. Deb.	5	5	63½	—	7 17 6
Brazil Tractions	Nil	Nil	31	—2	Nil
British Columbia Elec. Rly. Pfds.	5	5	58	—	8 12 4
do. do. Preferred	5	93/-	52	+1	*9 3 6
do. do. Deferred	3	124/-	57½	—	*10 17 0
do. do. Deb.	4½	4½	61½	—	6 18 3
Mexico Trams, 5 per cent. Bonds	Nil	Nil	55½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	97½	—	Nil
Mexican Light Common	Nil	Nil	13	—	Nil
do. Pref.	Nil	Nil	27	—	Nil
do. 1st Bonds	Nil	5	61½	—	8 3 8
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	16	28	—	6 14 9
British Aluminium Ord.	10	10	15/-	+6d.	—
British Insulated Ord.	15	15	1¼	—	10 0 0
Callenders	15	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	18/9	—	6 18 8
Crompton Ord.	10	10	18/9	—	14 11 0
Edison-Swan	10	—	6/-	—	—
do. do. 5 per cent. Deb.	5	5	64	—	7 16 3
Electric Construction	10	10	18/3	—	10 19 2
English Electric	8	8	10/-	—	16 0 0
do. Pref.	6	6	12/6	—	9 12 0
Gen. Elec. Pref.	6½	6½	17/-	—	7 18 0
do. Ord.	10	10	18/9	—	10 19 2
Henley	15	15	29/3	—	10 5 7
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	—	3/9	—	—
Met.-Vickers Pref.	8	8	1⅝	—	9 2 10
Siemens Ord.	10	10	1-/-	—	*9 8 2
Telegraph Con.	20	20	21½	—	*8 11 9

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, December 28th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic per lb.	8½d.	..
a Ammoniac Sal per ton	£55	..
a Ammonia, Muriate (large crystal) ,,	£58	..
a Bisulphide of Carbon ,,	..	..
c Borax ,,	£31	..
a Copper Sulphate ,,	£20	..
a Potash, Chlorate per lb.	6d.	..
a ,, Perchlorate ,,	6d.	..
a Shellac per cwt	£16 14s.	..
a Sulphur, Sublimed Flowers ,,	£14 10s.	..
a ,, Lump ,,	£13 10s.	..
a Soda, Chlorate per lb.	3½d.	..
a ,, Crystals per ton	£7	..
a Sodium Bichromate, casks per lb.	6½d.	..
METALS, &c.		
p Babbitt's Metal and Anti-friction Metal—		
Grade I per ton net	£160	..
Grade II ,, ,,	£118	..
Grade III ,, ,,	£71	..
c Brass (rolled metal 9" to 12" basis) per lb.	10½d.	..
c ,, Tubes (solid drawn) ,,	1/0½ to 1/0¾	..
c ,, Wire, basis ,,	11½d.	..
c Copper Tubes (solid drawn) ,,	1/2½	..
c ,, Bars (best selected) per ton	£98	£3 dec.
c ,, Sheet ,,	£98	£3 dec.
c ,, Rod ,,	£98	£3 dec.
d ,, (Electrolytic) Bars ,,	£75 5s.	..
d ,, ,, Sheets ,,	£145 10s.	..
d ,, ,, Wire Rods ,,	£91 5s.	..
d ,, ,, H.C. Wire per lb.	11⅛d.	..
f Ebonite Rod ,,	3/6	..
f ,, Sheet ,,	3/-	..
g German Silver Wire ,,	2/9	..
h Gutta-percha, fine ,,	12/6	..
h India-rubber, Para fine ,,	1/3½	..
j Iron Pig (Cleveland Warrants) per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual. ,,	£27	..
g Lead, English Pig ,,	£26	£1 dec.
g Mercury per bot.	£10 7/6 to £10 10s.	..
a Mica (in original cases) small per lb.	8d. to 3/-	..
a ,, ,, ,, medium ,,	4/- to 8/-	..
a ,, ,, ,, large ,,	10/- to 20/- & up	..
p Phosphor Bronze, plain castings ,,	1/2	..
p ,, ,, drawn bars and rods ,,	1/4½	..
p ,, ,, rolled strip & sheet ,,	1/4½	..
p ,, ,, Wire ,,	1/5½	..
d Silicium Bronze Wire per lb.	1/2½	..
r Steel, Magnet, in bars ,,	1/6	..
n Tin, Block (English) per ton	£172 to £173 10s.	£3 to £3 10s. in.
n ,, Wire, Nos. 1 to 16 per lb.	3/6	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
j Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Smoke Abatement.—The Committee on Smoke and Noxious Vapours Abatement appointed by the Ministry of Health, has presented its final report (H.M. Stationery Office, price 6d. net.). The examination of numerous witnesses has satisfied the Committee that means for heating, cooking, &c., which produce little or no smoke are available. The use of electricity is hygienic and labour saving, but in view of the high prices charged at present its adoption is retarded. The cheapening of electricity will no doubt lead to its inclusion in the design of the cooking and heating arrangements of houses. Subject to this, the Committee thinks that wherever gas is available it should be employed in lieu of the old-fashioned coal range, which is condemned as wasteful of fuel and labour, and productive of smoke. For a supply of hot water a coke-fired boiler is recommended. It is considered that the present situation regarding housing, presents an excellent opportunity for the constructive reform of heating and cooking systems, as it has been urged that it is impracticable to attempt smoke abatement by altering existing arrangements forming a part of old-fashioned houses. The Committee is not in the position to recommend the universal adoption of any particular scheme, but is of the opinion that in most instances it will be quite practicable to adopt some arrangement which will obviate the production of smoke. The Committee recommends that every facility should be given to gas and electricity suppliers to increase and cheapen their commodities, and it condemns the practice of some local authorities which charge unnecessarily high rates for gas and electricity for the purpose of contributing sums to rate-relief.

A Magnetic Survey.—The magnetic survey yacht, *Carnegie*, returned to Washington on November 10th, 1921, after completing her two years' world cruise. Although a considerable amount of rough weather was encountered, *Science* records that it was found possible with the special apparatus on board to make satisfactory magnetic and electrical observations daily.

AUSTRALIA'S FUTURE AS A MANUFACTURER.

Of the recently-issued report on the economic situation of Australia, by H.M. Senior Trade Commissioner (Mr. S. W. B. McGregor), probably the most interesting portion to engineering readers is that dealing with the question of developing Australian manufacturing industries.

There is, Mr. McGregor says, much exaggeration in the utterances of public men and in the Press as to the enormous developments of manufacturing industries in Australia, which are alleged to have taken place in the last few years, and the ease with which new industries might be established or existing occupations stimulated so as to "cater for the whole of Australian requirements."

On the other hand, the Australian has the inherited British manufacturing instinct and quality of enterprise.

Labour Factor.

In addition, Australia possesses all the raw material necessary for manufacture, an almost unlimited supply of economical power, and a healthy temperate climate. An important, if not determinating, factor in the successful exploitation of Australian manufacturing enterprises is the attitude of organised labour. Mr. McGregor adds:—

"Without emphasising this point, one may say that, assuming the co-operation of labour, a very high degree of organising ability will be required to enable labour to enjoy that high standard of living which it rightly demands, and, at the same time, to permit goods to be produced at a reasonable, if not competitive price."

It is fairly obvious that manufacturing industries in Australia cannot extend much further without the introduction from overseas of capital, labour, and not least, men with specialised knowledge and organising ability. A number of British manufacturers have already established branches, contemplate establishing branches, or have linked up in some way with established manufacturing interests.

Summarising the situation, the Senior Trade Commissioner says that there is apparently an immense field for the natural development of manufacturing industries in Australia, although that development may not be so rapid as many desire.

The Government stimulus to manufacturing industries consists in (*a*) a highly protective Customs Tariff; (*b*) the activities of the Institute of Science and Industry and the Bureau of Commerce and Industry.

State Assistance.

On the subject of effecting the much-needed increase of population in Australia, H.M. Trade Commissioner admits that the only way is to develop the secondary or manufacturing industries. Of the different phases of the Australian Government's policy, its immigration scheme is viewed more favourably in this country than the highly protectionist tariff which is to be enforced. The Government also assists both primary and secondary industries by means of the Bureau of Commerce and Industry and the Institute of Science and Industry. The former is developing into a permanent Department of State. Latterly its activities have been more particularly directed to the preparation of schemes for fostering and organising the secondary or manufacturing industries with a view to local consumption and overseas export. The Bureau lends its support to co-operative methods, and is endeavouring to promote associations of manufacturers and merchants for purposes of combined action in making, buying, and selling arrangements.

Mention should here be made of the Australian Producers' Wholesale Co-operative Federation, Ltd., which has opened offices in London to sell produce and purchase machinery, stores, &c., to the best possible advantage.

Before passing from questions of co-operation, it may be stated that the Australian Association of British Manufacturers and their representatives has during the year successfully dealt with many important matters. Its members now number 321 representatives in Australia, and 462 manufacturers in the United Kingdom.

Engineering Standardisation.

The formation of an Australian Engineering Standards Association has been the subject of a conference between the Institute of Science and Industry and the Institution of Engineers, Australia, whereby the general scheme of organisation, as set out in a pamphlet issued by the Institute of Science and Industry, was approved, and it was decided that a recommendation be made to the Commonwealth Government urging the formation of an Engineering Standards Association, and the early appointment by the Government of a main committee.

It was also recommended that the headquarters of the Association be located in Sydney at the headquarters of the Institution of Engineers, Australia, whose secretary should also be secretary of the Association, and that while the Institution is prepared to assist with funds and secretarial work, the Government be asked to supply such additional funds as may be necessary to carry out the work efficiently. Mr. Knibbs has since been appointed secretary.

Hydro-Electric Development.

Australia as a whole offers little prospect of hydro-electric development. Various schemes have been proposed in New South Wales and Victoria, but have not passed the preliminary stages. What is known as the Kiewa River scheme, in Victoria, recently received careful consideration from the State Electricity Commissioners, who decided that the scheme must be deferred for the present.

Preliminary work in connection with various schemes in New South Wales is well in hand. The Snowy River scheme proposed to commence with 24,000 kW, increasing to 150,000 kW. Estimates with regard to the Clarence River scheme indicate that some 80,000 h.p. is continually available.

In Tasmania, the Hydro-electric Department of the Tasmanian Government continues general extensions and survey work. The power at present available is 15,000 h.p., but the plant is capable of generating 18,000 h.p., given sufficient water supply. It is intended that work shall now proceed continually until the full 57,000 to 66,000 h.p. is made available. The total cost is estimated at £2,500,000, of which £1,200,000 had been spent by June, 1920, and £554,000 voted for the year 1920-21.

Each month sees large quantities of machinery and equipment landed at Hobart for the extension of the scheme of the Hydro-Electric Department, and the general manager recently returned to Tasmania after visiting England and America to investigate the question of supplies and to place orders for plant and material. Construction work is progressing well all the time. The financial position, as revealed by the accounts for the past departmental year, is entirely satisfactory, and there is no doubt that the bold policy of the Tasmanian Government in harnessing the State's water power is more than ever justifying itself now that the promoters of so many new industries have been induced to make Tasmania their sphere of operation.

During the year 1920 the Electrolytic Zinc Co., at Risdon, near Hobart, recovered from the ore treated 5,809 tons of zinc, valued at £251,150, and employed an average of 970 men. This company is hurrying through with its big construction programme, and expects to start producing in December (this month) from 80 to 100 tons of electrolytic zinc per day. Owing to the price of spelter falling below the actual cost of production on the 15-ton-per-day unit, the plant was closed in February, and no further zinc will be produced until the big unit is in commission. The closing down of the spelter plant necessarily stopped the production of zinc oxvides, leaded zinc oxides and rolled zinc sheets, but these subsidiary production plants will start up again in due course. The end of the year should see the Electrolytic Zinc Co. producing on a very large scale. The importance of this undertaking from an all-Tasmanian point of view will be realised when consideration is given to the amount which the Government has spent in extending its hydro-electric scheme, primarily to provide power for this and other industries which have been started.

Morwell Scheme.

It may be recalled that the total estimated cost of the Morwell electric scheme for developing the brown coal deposits of Victoria is just under £3,000,000. Various details have appeared already in these columns. The preparatory work on the new power house at Morwell (80 miles east of Melbourne) is well in hand. Tenders have been accepted for the plant, and the station is expected to be in operation before the end of 1923. The estimated selling price of electricity in the metropolitan area of Melbourne is .43d. per unit.

In addition to the transmission of electricity direct to the Metropolis, provision has been made for a separate transmission line, carrying energy at a pressure of 20,000 volts, to be erected alongside the main transmission line. From this lower voltage line it is intended that electricity shall be made available to the various towns and villages *en route*.

The whole of the designs for the power-station plant and transmission lines were prepared by Mr. H. R. Harper, chief engineer to the Electricity Commissioners, and his staff.

Schemes are also under consideration for transmission of energy from Morwell to country centres, such as Ballarat, Bendigo, and Geelong.

Since the first appointment of the Commissioners, the Melbourne demand has grown to such an extent that it became necessary to make arrangements for a station of 15,000 kW capacity to be erected within the metropolitan area at Newport. This station will supply the demand in excess of the capacity of existing generating stations in Melbourne until the Morwell power house is in operation. Thereafter it is intended that this station shall be used to carry the "peak" loads only, the more constant demand being met by the Morwell station.

The plans of the Commissioners include providing the necessary equipment to link up the Morwell station, the Railway Department's power station at Newport, and the Commissioner's proposed Newport station, so that all these stations and any future extensions can be operated as one scheme. This arrangement not only ensures economic working, but greatly reduces the risk of any interruption of supply.

THE FARADAY SOCIETY.

Some Curious Properties of Commercial Cadmium.

At the November meeting of the Faraday Society, Mr. J. Neill Greenwood read a paper entitled "The Effect of Cold Work on Commercial Cadmium." Preliminary researches on the mechanical properties of this metal have produced some curiously anomalous results. Most metals become hardened when cold work is done upon them, but this metal (which consists of 99.75 per cent. cadmium and 0.25 per cent. lead) is harder when cast than when the cast ingot is hammered. Moreover, while the worked metal continues to soften very appreciably for some days after hammering (unlike other metals, which first become harder on standing, and then gradually soften), in the unworked cast metal a very slow softening takes place. It is concluded that chill cast cadmium undergoes a spontaneous change from a harder to a softer state, and this transformation is greatly accelerated by deformation in the cold. Microscopic examination confirmed this supposition, and showed that cadmium spontaneously anneals after cold working, and, as usual, the growth of the new crystals is most rapid in the initial stages. This spontaneous recrystallisation takes place at ordinary temperatures; at 20 degs. C. it is complete in about 12 days.

The explanation offered for this behaviour is that two different allotropic forms of cadmium are being dealt with, and that the transformation from one to the other, which is shown to take place at about 60 degs. C., is suppressed by the quick cooling in chill casting, so that the metal is in a metastable condition. The explanation is in harmony with the well-known views of Ernst Cohen on allotropy in cadmium, based on quite different considerations.

The Synthetic Production of Ammonia.

The remarkable success of the Haber process in Germany, and, it would appear, of the more recent Claude process in France, for the fixation of nitrogen by its direct combination with hydrogen, gives a special interest to all experimental work bearing on this synthesis, even if the results turn out to be negative. This is the case with experiments planned by Dr. J. N. Pring and Mr. E. O. Ransome, and described before the Faraday Society, to discover whether recently-formed cathodic hydrogen, which may be presumed to be in an abnormally active state, may be made to combine with nitrogen under high pressures at normal temperatures. There is reason to believe that when hydrogen is formed electrolytically at a cathode, not only is it at first in the atomic condition, but it accumulates at very high pressures within the surface of the electrode. Such conditions should, therefore, be most favourable for the N-H synthesis. In the apparatus described in the paper it was possible to carry out the electrolytic production of hydrogen in an atmosphere of nitrogen at pressures up to 500 atmospheres. Nevertheless, no reaction took place between the gases at the cathode. This conclusion lends support to the view that the powerful reducing effects brought about by hydrogen under these conditions of high over-voltage are caused by ionic interchanges rather than through secondary chemical reaction with free hydrogen. The inertness of nitrogen under these conditions may thus be attributed to absence of ionisation at the low prevailing temperatures. The results are further in accordance with the view that the transition from hydrogen ions to the gas under a state of high pressure takes place in the inner layers of the metal, and not on the outside surface.

The Properties of Emulsions.

A newly-discovered property of an emulsion was described by Mr. T. C. Nugent. The emulsion concerned was a fairly concentrated one of benzene in water, containing gelatin or gum arabic as "stabiliser." A convenient method of making these emulsions is given in the paper. It was observed that the addition of caustic soda to such an emulsion caused separation of the benzene to begin at once, provided the soda were added to a freshly-made emulsion. This separating effect of caustic soda is thought to be due to the transformation of the gelatin into some less colloidal condition and the consequent breaking down of the protecting gelatin layers round the emulsoid particles. If, however, an emulsion was produced and left undisturbed for some time, and then caustic soda was added, it was found that the separation of the benzene was retarded or "inhibited" for some time.

The suggested cause of this phenomenon is, that after an emulsion is produced, the gelatin is slowly forming protecting layers about the benzene particles, and therefore the stability of an emulsion increases with its age. Before the benzene particles can be caused to coalesce these protecting layers must be removed by the caustic soda. As the strength and number of these protecting layers are increased so much the time required for their removal or destruction by the caustic soda be increased.

A Complex Lead Nitrate Anion.

Mr. F. H. Jeffery has been investigating the electrolysis of aqueous solutions of alkaline nitrates, using various anodes for the purpose. In the experiments now described lead was the anode, and it was found to go into solution, forming a complex which gave a bright orange colour to the anolyte. The complex lead anion was derived from divalent lead, and was thought to be $(Pb(NO_2)_4)''$ for small concentrations of lead in alkali nitrite solutions. In the author's view this complex is probably the only one formed.

The solid in equilibrium with solutions obtained from anolytes of certain concentrations is lead nitrite crystals $Pb(NO_2)_2 . H_2O$. The colour of these crystals is approximately the same as that of the solutions from which they are derived, showing that the plumbo-nitrite complex probably maintains its identity in the crystals. A direct way of testing this hypothesis would be by an X-ray analysis of the crystals; the $(Pb(NO_2)_4)''$ group should form a pattern regularly repeated in three dimensions relative to the cationic Pb atoms.

Negative Catalysis.

A suggestive paper by Dr. N. R. Dhar and Mr. N. N. Mittra, sent in from India, pointed out that in oxidation reactions negative catalysis takes place when the catalyst is readily oxidisable. The well-known theory of intermediate compounds is utilised to explain the reactions described. Experimental evidence was put forward to support the view that generally one chemical change will promote or induce another of the same type, and the remarkable fact was observed that this effect is particularly noticeable in those reactions which are very sensitive to light.

At the conclusion of the meeting Dr. S. Judd Lewis and Miss F. M. Wood exhibited an improved form of sensitive thermostat, specially designed to operate at all temperatures between 0 deg. and 100 degs. C.

TELEPHONE LINE WORK IN THE UNITED STATES.

Discussion at Leeds.

At a meeting of the North Midland Centre of the Institution of Electrical Engineers on November 29th Mr. E. S. Byng read his paper on the above subject (an account of which appeared in our issue of November 25th). The paper was illustrated by means of lantern slides and samples of telephone apparatus used in America.

Mr. Johnson (Leeds), who opened the discussion, observed that America, being the best telephone country in the world, could show them a great deal, and he hoped that much would be learned. However, it did not follow because a thing was done in America they should necessarily do the same thing in England. The conditions were very different. He would like to see some of the appliances illustrated and methods described carried out in an old English city, say, like York, with narrow streets, both cramped and tortuous, with the ground full of pipes of various kinds, including old pipes that had been allowed to remain to block up the place. Cities in America were separated from each other by spaces which were out of comparison with the smaller spaces in England. In England they could show something considerably better than the American staff organisation, which the author described.

In connection with motor transport and the use of motor cycles, it was said that 250 men were engaged on the maintenance and repair of 1,000 vehicles—an average of one man to four vehicles, which struck one as being very excessive, and yet whilst there were all sorts of engineers they did not employ a motor engineer.

In the use of mechanical appliances the Americans had gone far ahead. Roads were being made more costly and substantial, and consequently much more costly to tear up. If, when streets were being widened or re-made, they could build subways for gas, water, and power mains, telegraph and telephone cables, &c., the lot of all engineers would be lightened considerably, and it would be a good investment for the towns that carried out such work in the long run. In England it was absolutely true that any position in the Post Office engineering system was open to anyone who became qualified for it. They had a living proof of that in the fact that the present engineer of the Post Office started life as a telephone messenger in Aberdeen and, without any outside influence, attained by the force of his own character and ability the position he now held.

Mr. Selvey (Sheffield) said that a serious number of propositions with regard to subways had been put forward from time to time, particularly with regard to London, and ultimately he thought the matter would mature very considerably. If they had to consider how to bring a batch of cables from any of the proposed super-station sites into the heart of London they would have a very serious problem to consider. In one case the most feasible way seemed to actually bring the cables through the main sewer. That might sound a little bit humorous, but it was practically saying, "Use existing subways." Their American friends had specialised to a very considerable extent in their big cities, but their main problems had been to connect rival metropolises, between which was practically virgin country. If property laws in America were very much the same as those in England, how could they drive their caterpillar tractor and plough over somebody's land without any regard to anything but the shortest distance between the two points? Every English

engineer knew what would happen to him if he tried to find the shortest distance between two points—it could not be done. He did not see how they would gain much by using aerial cables.

A main point of the paper was that open wiring was condemned, and they were fast reaching that position in this country. In this country the atmosphere was very acid, and aerial cables would have to be regarded from exactly the same point of view as a bridge. What kept bridges standing?—not steel, but paint, and if they used aerial cables they would only be preserved provided their coverings were continuously renewed. The other great lesson of the paper was that of replacing labour.

Mr. F. E. Gibbins (Leeds) said that the greatest objection in this country to the use of aerial cables along country roads was the great difficulty they experienced in dealing with trees. In the Leeds district a number of aerial cables which were used for junction circuits between adjacent towns were rapidly being placed underground. They wanted to see the last of the aerial cables, as they had given endless trouble. Clamping the suspension wire to the pole, he thought, was infinitely preferable to their method of dead-ending it. They had tried the patent stays advocated in Mr. Byng's paper, but they had not found them satisfactory. They adhered to the method of using wood blocks. Instead of their stay-splicing methods, clamps were used and the stay tighteners, which in England were found so useful, were not used, but it seemed to him that the English method was preferable to the American method. In America it would be possible to stay any pole, but in this country it was a great difficulty. In the great majority of cases they had to fix their pole, *not* where they would like, but where they could; English road margins were much narrower and their roads, too, were narrower. That to some extent would account for the fact that they were behind the Americans in the use of labour-saving devices. The method of binding wires on the insulators which they discarded in this country twenty-five years ago was still in use in America—*i.e.*, binding the wire to the insulator with soft wire of the same material. The tape and binder were much more effective than the old method. To space the arms on the poles 24 in. instead of 12 in., as in this country, seemed to be an extravagant use of pole space. Possibly more than 12 in. would be necessary in America; he could not see, however, why it should be as much as 24 in. The American cross brace was not sufficiently strong to support a ten-wire arm which was not balanced and which had not the same weight of wire on the one as the other. In this country they braced the arms together, an effective method where they had more than three or four arms. With two arms it was not effective; in this case the method did not seem to be as good mechanically as the English one.

Mr. E. H. Farrand remarked that, generally speaking, the impression one got from the paper was that the conditions in America were far more favourable to telephone engineers than anything they had in this country, both as regarded overhead line and underground construction. The use of a mechanical excavator appeared to be absolutely ruled out of court in England. The types of conduit that Mr. Byng described were pretty much on the lines of Post Office practice in this country, with the exception that of late years they had done away with the square ducts; the hole in the duct was made round, because they found it easier to align those ducts, to get round bends and corners with them, and to keep them joined together in a manner that excluded water and other interference. Lines of square ducts fixed together with dowels could only be adopted where they got straight lines. That was a thing they could never get in England, except in a country line; in a town a straight line was almost an impossible thing. One firm of contractors did boil out cable joints with wax, but the bulk of the contractors who laid cables in England did not. As against its disadvantages, no doubt the waxing of a joint did prevent to some extent damage accruing from defective plumbing spreading rapidly in a cable and throwing it out of action in a short time. However, that object was attained much better by the English method, which showed not only defects in the plumber's wire, but any defect in the sheath. They had finished a main cable from Leeds to Harrogate, and the results showed from 40,000 to 50,000 megohms per mile. He had never seen a waxed cable that was as good, and he was very doubtful whether that could be bettered. The rates of jointing given by Mr. Byng were exceedingly high. For instance, every one of those wire joints in England consisted of six separate operations, so that six times three hundred in one hour was indeed a nimble operation for a man's fingers. Of course, if the mate was doing a large part of the work, then there were two men employed, and if that was so, then they had men in Leeds who could do the same. Had the speed of pulling a cable through a duct in America of 50 ft. per minute any ill-effect on the sheathing of the cable? The average of most of the big contractors in England was only from 20 to 30 ft. per minute. They had not, however, all the mechanical appliances which they had in America.

Mr. Longman was of the opinion that the large lead-covered cables would last longer and have a much longer life than the small lead-covered suspended wires which they had been using in this country. When they got up to 2 or 2¼ in. diameter they experienced much less trouble due to the fracturing of the lead. In the neighbourhood of a coal mine where they had coke ovens, by-product plant, &c., the atmosphere was not particularly suitable for the use of overhead construction of any description. In America they were practically free from such effects.

Mr. G. H. Hoole thought that some of the American work looked very rough work. The subject of easements and rights-of-way to an English engineer was most interesting. Lump sums were made in final settlement in America, and there were undoubted big advantages in that arrangement. There was also a great saving in clerical labour, but in England the power of the dollar did not equal the power of property owners. In England the small motor cycle and side-car had been found to be useful, and he could not understand why those machines had not been found more useful in America.

Mr. E. S. Byng, in replying to the discussion, said that in 1917 he had been loaned to the French Government for a short time to advise with regard to its long routes. The latest practice as developed in this country and in America was the underground route with a heavy-sized cable, and for three or four long-distance routes he had suggested a similar arrangement. The contracts were about to be placed when a deputation of Frenchmen came back from America and said they must stay their hand, and urged aerial lines and light conductors. As a result of his study in the U.S.A. his own outlook had been considerably broadened, but the position had to be weighed up. If they knew only one side they could not arbitrate fairly. Americans had placed their utmost confidence in the stability of the aerial cable, but it was not the right thing in this country. In France all the cables were taken through the main sewers; they could drive a carriage and pair through the various sewers. The suggestion that they should adopt sub-ways in the main streets of England if they were reserved for the utility services, telephone, telegraph, electricity, gas, and water mains would be a good solution of the congestion trouble. Regarding the preservation of the cable sheath, it contained 1 per cent. antimony, but it was not coated with paint or any means to prevent corrosion. Aerial cables were run in Pittsburg, which resembled Sheffield very much; the same amount of soft coal was used there, and it was just as dirty as Sheffield. Regarding manholes, not even in London had he seen conditions so bad as they were in New York, where they had some serious difficulties to contend with. In the U.S.A. the number of cross arms that tilted were surprisingly few. As to the speed in pulling in cables, the 50 ft. he mentioned was about the normal speed from several tests he made. The limit which they must not exceed was 200 ft., and in places similar to Oxford Street he saw them pulling in twelve and thirteen drums a day without any trouble. On a country road he watched the men at various points pulling in from twenty to twenty-five every day. Though he did not see the four miles pulled in he had no difficulty in believing it, as he knew it was a definite fact. Not only was the speed in pulling the cable in rapid, but it was rapid in moving from one manhole to another. They had three or four motors, so that the men did not walk. That was where they cut out the waste of time.

THE DEVELOPMENT COMMISSION.

Annual Report.

The important advances in the distribution of electricity to outlying rural districts in the Hereford area are covered in a broader manner in the report of the Development Commissioners for the year ended March 31st last.*

It is to be understood that the Hereford scheme was in the nature of an experiment, as no little uncertainty existed as to whether agriculturists would use electricity if a supply were available. It was the very essence of such a scheme that it should be free from any element of subsidy or favoured treatment, and that it should be conducted in an area displaying average features—neither favourable nor unfavourable to the work. In the opinion of the Commissioners these provisos were observed in the Hereford experiment. A 4,000-kW power station was built at Hereford for war purposes, and when the war ended the station would have been scrapped but for the institution of the rural electricity supply project. The Corporation arranged favourable terms for its purchase, and commenced its operations by taking power to Breinton, in which district farms were numerous and agriculture was highly developed. This first part of the scheme cost £13,000. In December last the Treasury approved a further loan of £19,857 for the distribution of power to the Leominster, Weobley and Kingston areas. In January the Corporation put forward an urgent request for sanction to the expenditure of a further £34,750 to furnish a transmission line and equipment to Ross and Lydbrook; for the Rotherwas sub-station; and for two-thirds of the low-pressure distribution cables. This sanction was given, and a loan advanced subject to the deduction of any amount received from the

* H.M. Stationery Office. Price 3s. net.

Unemployment Grants Committee. The expenditure, therefore, amounted to £67,607 up to the end of the year covered by the report. To complete the scheme further sections are required for (*a*) Ledbury and the Frome Valley area at a cost of £14,400; (*b*) Pontrilas and the Golden Valley area at a cost of £7,400; and (*c*) a third of the low-pressure distributors, costing £5,000. Owing to the present financial stringency it has been decided to defer this part of the scheme. It is considered that the work already done will serve to prove the success of the scheme. In recommending loans the Commissioners stipulate that the net profits derived from consumers on the lines provided by means of such loans shall, unless otherwise approved by the Commissioners, be applied to further extensions of the scheme, and that the scale of charges to consumers connected to these lines shall be subject to the approval of the Commissioners, who will see that no loss is incurred by the Corporation. Summing up the financial position, it is seen that, whilst the rural communities get power and light, the revenue received gives the city the use of modern plant and equipment, together with a lower selling price for electricity. The cost of the plant, if the scheme is successful, will not fall upon the ratepayers or consumers, but will be defrayed by the general revenue, the greater part of which will come from outside the city boundaries. Thus the city ratepayers possess a reasonable prospect of becoming the owners of a valuable plant within 20 years without any call upon the rates. The Commissioners say that although it is too early to form precise conclusions as to the success of the scheme on its financial side, the experiment has gone far enough to remove all doubts as to the readiness of the rural population to use electricity for light and power when once it is made available. The authorities have many applications for priority of treatment from owners, farmers, and all kinds of industries, in every area served by a transmission line. The preliminary canvass shows that non-users will be a negligible minority in every district. Apart from the advantages obtained by its use, electricity in the area is no dearer than is usual in most urban areas. The Commissioners were impressed by the numerous uses to which electricity is put. They found it being used, *inter alia*, for corn grinding, chaff cutting, cake breaking, pulping roots, milking, sawing and pumping. Farm houses, farm buildings, and cottages are electrically lighted, and electric ironing has become popular. Power is also used in cider making—an important local industry—sheep shearing, stacking, thrashing and cleaning grain, and in churning and milk separating. So far no steps have been taken to introduce appliances for ploughing and draining, but a scheme has been considered under which mole drainage and ploughing tackle would be hired out to farmers, and electric winches taking the place of steam winders. Power would be supplied to the fields by overhead distributors carried on Callender's collapsible steel poles, and to the winches by c.t.s. cable wound on spring drums. Some figures regarding the larger undertakings using electricity in the area are given in the report. There are two sawmills employing 80 people; two wheelwrights and blacksmiths with 20 employés; two flour mills with 90 hands; two cider works employing 100; two laundries (35); and an ironworks (35). Applications have also been received from a wire works and a timber moulding mill employing 1,000 and 100 men respectively.

The electro-culture investigations at the Imperial College of Science and Technology are briefly reported upon. The Electro-Culture Advisory Committee of the Ministry of Agriculture and Fisheries has come to the conclusion that electrification of crops by an overhead discharge is capable of bringing about increased growth and yield. Further research into the best conditions for bringing this about was to have been undertaken during 1921 and the Commissioners recommended a grant of £1,365 for this purpose.

ELECTRICAL APPARATUS IN THE HOME.

The second of the series of Salesmanship Conferences organised by the British Electrical Development Association was held in the rooms of the Chartered Institute of Patent Agents, London, on December 16th. Mr. J. W. Beauchamp (Director of the E.D.A.) presided, in the absence of Mr. S. T. Allen (President of the I.M.E.A., and Chief Electrical Engineer at Wolverhampton).

A paper on "The Selling of Domestic Electrical Motor-Driven Appliances" was read by Mr. E. R. Morton, who pointed out that in endeavouring to sell these appliances the salesman had at least one great advantage over the heating and cooking salesman, because the current consumption of the appliances was so small that it very rarely happened that any material saving in running costs could be effected by installing a power circuit. Another important asset was that every one of these appliances could, if necessary, be operated from any lamp socket. There was no vital objection to this course, except where the appliance was used in a building having a floor giving a good earth. However, it was usually so easy to fix up a socket with earth connections that in the majority of cases the progressive contractor would throw in this if he could secure the order for the appliance. The flexible supplied by most makers was suitable for ordinary use, but where conditions were likely to be severe it was sometimes desirable to fit a length of c.t.s. or tough rubber-sheathed cable.

The difference between success and failure in selling lay between a thorough knowledge of the appliances, their application and use, and a want of that knowledge. All the electrical appliances for the home were simple in design and construction, and a reasonable understanding of their fundamentals should not be beyond the grasp of any individual possessed of average intelligence, even if he had not the advantages of an electrical or mechanical training. Fortunately, most makers of domestic appliances were only too anxious to give the fullest possible information and instruction as regarded their product; the salesman should take advantage of this.

Having become thoroughly familiar with the appliances he was going to sell, he would find it very necessary to know something of competing machines. In the two main appliances available to-day, vacuum cleaners and clothes washers, there were many varieties, and he must be able tactfully to dispose of his competitors' claims to superiority. In doing so, however, it was vital that he must not suggest that the competing electrical appliance was no good at all; if he could not sell his own appliance on its merits he should not foster any idea in the mind of the general public that anything electrical did not fulfil its function. If a salesman were asked why his appliance cost more than a similar machine he should have no difficulty in explaining, because he was selling, not only an appliance, but an investment, which normally would not require replacing for a good many years. It was possible to show that price differences between competing machines was of quite minor importance. These appliances needed attention from time to time, such as oiling and minor adjustments; he should, therefore, make a point of calling a few weeks after the sale to see that the user was not only thoroughly familiar with its operation, but was also keeping it in order. When making these calls he would usually be able to obtain the names of the buyer's friends who might be interested.

Advertising should be the first step in the selling of apparatus. Probably the cheapest form (apart from getting the maker or wholesale distributor to do it) was to use type-written letters of an individual character, written so as to arouse interest, but without implying any sense of obligation. After a few days a call could be made. The door-to-door method, quite apart from loss of dignity was, he believed, unfertile. Pamphlets could be included with the letter, but every piece of advertising matter should clearly give an open invitation to see the appliances under actual working conditions—in the home itself. Once the prospective purchaser had used an appliance she was interested in, she was, nine times out of ten, loth to part with it. Results from advertising in local papers, the showing of films in kinemas, *solus* positions on good hoardings, &c., varied much in different districts, and should be carefully watched. The best advertising medium was a good show window.

On account of the weight and bulk of washing machines it was desirable to arrange for the initial demonstration to take place in the contractor's or dealer's showrooms, and later, it could be arranged to do an actual week's washing in the home. Even where there was quite a small family the salesman need have no hesitation in putting his figures either against the laundry bills or the washerwoman's fee.

With regard to ironing machines, while the roller was rotated either by coupling to a washing machine, or with a self-contained motor, the shoe was almost invariably gas heated. As the average length of the shoe to be heated was 3 ft. 9 in., the electrical method presented difficulties. Demonstration was necessary, and the salesman who had experience of washing machines would not have any difficulty in adding this line to his repertory.

Other machines mentioned by Mr. Morton were the dish-washer, a sewing machine equipped with an electric motor and foot control, electric fans, &c. The first principle in selling these appliances was to get interest aroused before stating prices. Good business would only be done with the help of a hire-purchase system, no matter at what prices appliances were sold. Too little attention had been given to the possibilities of hire-purchase systems by electrical traders. The quality of mind necessary to effect sales was enthusiasm, which was difficult to acquire unless one had an intimate and first-hand knowledge of the appliances to be sold. A salesman would be better able to sell if he had electrical appliances in his own house, and could speak with increased authority and confidence.

The central station engineer too often assumed that the load was so slight that it was not worth his while to cultivate it. That was a short-sighted policy. Possibly most dealers could cite instances of new consumers being converted to

electric light because it was a necessary preliminary to having labour-saving appliances.

Finally, Mr. Morton urged all salesmen and dealers to educate the public, and foster and encourage the all-electric home, and the time would come all the more quickly when the public would come to the dealer.

In a subsequent discussion Mr. Nobbs suggested the use of a schedule of prices, as published by laundries, and a comparison between those prices and the cost of doing the washing at home, pointing out also the various advantages. With regard to cost, the electrical washer was much more costly than the power-driven washer used in steam laundries, and he did not think it was all due to the motor. He did not see why it should cost more. The speaker also advocated a number of improvements to existing types of electric washing machines, such as the addition of hydro-extractors and larger wringers. With regard to vacuum cleaners, he suggested the preparation of a schedule of savings effected by using a vacuum cleaner, compared with the cost of extra servants.

Mr. J. G. Whyte said he had made inquiries of a British manufacturer about the price of a certain washing machine, who had given him a considered estimate of what it would cost him to make 50 of those machines, now sold at about £60. The price to a contractor was £35 each. Was not the margin between the cost of production and the actual selling price now too high?

Mr. Roberts urged contractors to institute a system of maintenance for machines, because there was a feeling amongst the public generally that anything to do with electricity did not need attention. With a washing machine in his own home he saved from 15s. to 18s. per week on laundry bills.

Mr. W. E. Warrilow said the cost of a washing machine had a great deal to do with slow sales. Another disadvantage was the noise it made in operation. These conferences had thrown into the boldest possible relief the necessity for something more than merely individual effort. He had noticed that at Felixstowe a public wash-house had been fitted up where the public could do washing with electrical machines. As to the vacuum cleaner, was it not time that they had a standard machine?

Mr. Young said the only way, to his mind, to sell electrical appliances to the public was for the manufacturers to advertise in the daily Press first. Salesmen should think of methods of educating servants. The only way to get washing machines into a house was by the hire-purchase system. As to high prices, he did not blame manufacturers entirely, because they had to do a great deal of experimental work, and if they got no return for that he was afraid there would be no inducement to try. Something might be done to reduce the noise of vacuum cleaners. Reductions in the price of electricity were necessary, and would lead to much business.

Mr. Prentice, speaking with regard to the noise of vacuum cleaners, suggested their installation in the cellars of houses, and plugs in each room, to which vacuum cleaners could be attached, so that the noise of the motor would be in the cellar and the weight would be reduced. As to the extensive use of washing machines in America, he had been told that they were used a great deal in factories for washing bolts and nuts, so that the domestic side was not the only outlet.

Mr. Nobbs did not consider the central dust removal plant scheme would be practicable except in such places as hotels and other large buildings. He did not think the noise was a serious disadvantage.

Mr. Falk supported the view that the big stores should be asked to help in bringing the value of electrical machines to the notice of the public. Once the demand was created the price would go down. The noise of the vacuum cleaner was a matter of the design of the motor, and directly the design was improved the cost would go up.

Mr. Pooley urged the necessity for getting the architect and the builder to lay out a part of a house where all domestic duties could be performed, and where electric labour-saving appliances could be fitted up. There could be electric motors, and the whole of the apparatus could be driven from a short length of line shafting.

Mr. Harrison, an American, dealing with the extensive use of washing machines in America, said the modern machine did not make much noise. It was extensively used in apartment houses in America, and the only noise was the hum of the motor, which was very small. A good many of the apartment houses in the United States were equipped with washing machines by the owners before the tenants moved in. With regard to methods of selling, when dealers were enthusiastic they would get busy; a dealer or salesman who had not sufficient faith in the apparatus he was selling to use it in his own home could not be successful.

Mr. Palmer urged that the supply authorities should do more to give a supply of electricity, and not keep people waiting for an indefinite period.

Mr. Morton, in reply to the discussion, said he did not agree with the provision of drying apparatus with washers. Artificial drying made the clothes grey, unless bleaching powders, which were destructive of clothes, were used. The present-day wringer was sufficiently large to his mind, because it would take the largest blanket that could be bought. With regard to prices, and the £60 washing machine, he pointed out that the propaganda work had to be done mainly by manufacturers at the present time. As to maintenance of washing machines, he suggested that free maintenance should be given for a time. Advertising was very necessary, but the biggest advertising campaign in the world would fail unless the general public could walk into a dealer's shop and see the goods. Many a dealer had not even a vacuum cleaner in his showroom, much less a washing machine. He did not favour the idea of going to the big stores. The contractors could get into more intimate touch with their customers than could the big stores. Although he agreed that the architect and the builder should be educated, they wanted to get electrical appliances into the houses already built. Whilst also agreeing that it was difficult to obtain connections for electricity, Mr. Beauchamp had told him that there were nearly a million houses electrically equipped in the country, so that if only a small proportion of those were supplied with appliances there would be a good return.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Benjamin" Lightmeter.

That there is a growing recognition of the vital importance of correct lighting in industry is evidenced by the many enterprising concerns which have entirely remodelled their lighting installations. In making these improvements it is necessary to decide how much light is needed for various industrial processes, and to have a means of verifying the results by actual measurement.

A little device recently perfected—the "Benjamin" lightmeter, fig. 1—meets these requirements. It consists of a compact and well-finished lightproof box, utilising inside a small lamp of known candle power which illuminates a graduated standard surface against which the actual illumination at any point can be compared. No technical knowledge is required to use the instrument effectively, and it can be carried about as easily as a small camera. It can be connected to any 4-volt (2-cell) accumulator or dry battery, and a certificate is supplied with each instrument by the manufacturers showing the battery voltage and current used in the calibration of the scale. Photometric balance is obtained by moving the top screen backwards and forwards until the grease spot in the centre attains the same degree of luminosity as the comparison screen surrounding it. The illumination in foot-candles is then indicated in the opening immediately above. To measure candle power, the instrument is held at a definite distance in feet from the light source to be measured, with the screen directly facing it. The reading in foot-candles when multiplied by the distance squared will give the candle power of the source. The range of the standard instrument is from 0.5 to 20 foot-candles, but this can, of course, be varied for special purposes if desired. A section showing the interior is given in fig. 2, which also shows the graduation of the scale.

Fig. 1.—The "Benjamin" Lightmeter.

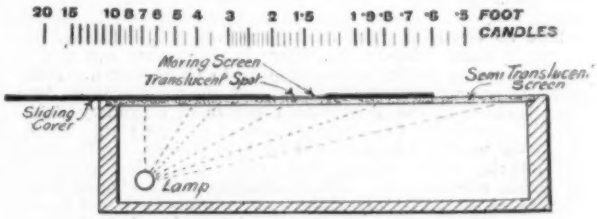


Fig. 2.—Interior of Lightmeter, and Scale.

The lightmeter is made by Benjamin Electric, Ltd., Brantwood Works, Tottenham, N.17. The inventor and patentee is Mr. Haydn T. Harrison.

An Electric Siren.

Fig. 3 illustrates an electrically-driven siren, one of a number of types manufactured by Messrs. Gent & Co., Ltd., Faraday Works, Leicester. This is a "two rotor" machine,

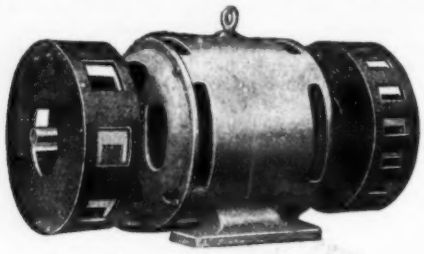


Fig. 3.—A "Two-rotor" Siren.

one rotor having eight "voices" or vents, and the other sixteen. As many as eight rotors giving different tones can be supplied. An adjustable-programme contact-maker for use with sirens is shown in fig. 4. This apparatus is driven by an impulse clock movement, and contains an aluminium wheel, 12 in. in diameter, provided with 288 holes,

Fig. 4.—Adjustable-programme Contact-Maker.

representing every five minutes for 24 hours. By inserting pins into selected holes, any programme of tunes may be fixed. These pins make contact by pressing two springs together for a few minutes before the signal is required, and when the actual moment arrives, another pair of contacts is made, completing the circuit of a relay which cuts in the power to the siren.

A Pulpit Lighting Fitting.

The Lodge Fittings Co., Ltd., 57, Albert Road, Aston, Birmingham, the patentee and sole manufacturer of the "Classic" pulpit or desk fitting described in the Electrical Review some time ago (17/12/20, p. 799), has introduced a less expensive fitting on the same lines. The diameter of the reflector is 1¾ in., and its length is 7 in. One lamp only is fitted, adjustment is made by the movement of the swivelled legs. The fitting has been named the "Classic Junior."

Electricity for Collieries.—In a paper on "Public *v.* Private Supply from a Colliery Standpoint," recently read before the Yorkshire branch of the Association of Mining Electrical Engineers, Mr. Robert Nelson sums up as follows: In mines where no electrical plant exists, and where it is desired to supplant steam winders, &c., there is no question but that a supply from a public undertaking is to be preferred. This, not only on account of the initial cost of an installation, but also because of the intermittent nature of a colliery load, which necessitates the putting down of a large plant, which will have to give a light output for long periods. In the case of collieries which already have some generating plant of moderate efficiency, the author considers that a change from private to public supply will almost always be found beneficial, mainly for the same reason—high peaks of short duration. Public supply authorities, who, at first, were dubious about supplying collieries, have come to appreciate that the peay loads of individual collieries so arrange themselves as to give a reasonable load factor on the system as a whole; they are therefore now generally agreeable to supply on specially-arranged terms. Where a colliery has a large surplus of coke-oven gas there are many advantages in co-operation with a public supply authority, *i.e.*, the running of a surplus-heat generating station feeding into the authority's mains when excess energy is available.

HIGH TAXATION: ITS CRUSHING EFFECT ON INDUSTRY.

The following is a copy of a letter which was forwarded on December 19th to Sir Robert Horne, the Chancellor of the Exchequer, by Col. O. C. Armstrong, the President of the Federation of British Industries. The mass of evidence collected by the Federation from the chief industrial centres of England, Scotland, and Wales shows that the present burden of taxation is crippling the efforts of manufacturers to recover and extend their foreign markets, and is stifling the possibility of a trade revival, which is so urgent if an alleviation of the present unemployment position is to be brought about.

The Federation in this communication warns the Government of the certain consequences that will result if taxation on industry is maintained at its present high level. As already stated in the Electrical Review, the organisation is pressing the Chancellor of the Exchequer for a reduction of the Income Tax and the abolition of the Corporation Profits Tax.

[copy.]

To The Rt. Hon. Sir Robert S. Horne, G.B.E., K.C., M.P.,
The Treasury,
Whitehall, S.W.1.

Sir,

The Federation of British Industries has just concluded its annual investigation into the effects of the past year's taxation, and the views of industry as to the future. In the course of this investigation general meetings were held at Sheffield, Nottingham, Bristol, Swansea, Leicester, Dundee, Edinburgh, Glasgow, Newcastle, Northampton, Birmingham, Liverpool, Manchester, Bradford, and Leeds, at which unanimous resolutions in the most emphatic terms were passed demanding the abolition of the Corporation Profits Tax and an immediate and substantial reduction in the rate of the Income Tax.

The fall of prices and values during the past year has been unprecedented both in extent and rapidity, with the result that the effects of taxation have been felt by industry with peculiar severity.

The capital resources of many industries have already been strained to the utmost by the need for larger working capital to meet post-war conditions of production, and the operations of the Excess Profits Duty have prevented the accumulation of reserves sufficient to meet so serious a crisis, while enormous local taxation and the Corporation Profits Tax still further depleted the available resources of industry during the year.

Under these circumstances the burden of Income Tax at a high rate, assessed upon the average of the three years which included the greatest industrial boom in history, has assumed crushing proportions, and many firms have already been driven to impair their future productive capacity by paying the current year's taxation out of capital or by loan.

It is fully realised that high taxation has only been one among the many contributory causes of the present depression. It is, however, the only one of these causes which can be mitigated promptly by the independent action of His Majesty's Government.

The chaotic condition of the exchanges, the adverse financial and political conditions prevailing in many of our principal markets, and the general disorganisation of the world's commercial system are all susceptible of remedy, but the remedy will take time, and most of these factors will still be in operation to restrict trade and hamper production during the forthcoming year.

Under these circumstances it was the unanimous opinion of the District General Meetings that any attempt to maintain taxation at its present level during the forthcoming year must at best seriously retard any industrial recovery, and at the worst may involve a permanent diminution in the productive capacity of the country.

The evidence brought forward at these meetings by speakers from all industries showed that the present rate of taxation is stifling initiative, postponing development, and crippling the efforts of manufacturers to recover and extend the foreign markets, which are now of such vital importance to the welfare of the country.

The Federation warned the Government last year that industry anticipated the most serious results from a continuance of high taxation. The meetings of this year afford overwhelming evidence that this warning was fully justified, and have disclosed the gravest alarm as to the future if the present level of taxation is maintained.

The Federation desire to urge you most earnestly to consider the grave danger to the economic position of the country which will be involved by disregarding this warning a second time, and to realise that the question is not now one of mere hardship or even of possible disaster to individual firms, but whether the whole industrial system of the country can possibly withstand any prolongation of the strain to which it has been subjected.

They feel that it is outside their province to suggest to you the means by which a sufficient reduction of taxation could be rendered possible. They wish, however, to place on record their conviction that under the present circumstances Government activities must be reduced substantially below their pre-

war level. They are fully aware that such a reduction will involve the sacrifices of many activities admirable in themselves and valuable to the country, but it is, in their opinion, better to face these sacrifices now when so doing may avert still more serious consequences, than to postpone them to a future date, when the ruin of industry and a dwindling revenue will force them upon the country.

They trust that the Committee which has been sitting under the chairmanship of Sir Eric Geddes will be able to suggest to you economies sufficient to enable the necessary reduction in taxation to be effected immediately, since they are convinced that such a reduction would have a psychological effect both at home and abroad which would be of the utmost value at the present moment in restoring confidence and enterprise, and indeed might of itself alone provide a sufficient stimulus to start the revival of trade which is so urgently needed.

They are firmly convinced that a substantial reduction of taxation would in a short time so increase the general volume of trade as to yield a larger revenue than could possibly be hoped from its maintenance at a higher level.

The Federation feel that they would fail in their duty as the responsible and representative organisation of industry in this country if they did not use their utmost endeavours to impress upon you and upon His Majesty's Government their firm conviction that any step, however bold, is preferable to the certain consequences of the maintenance of taxation at its present level.

I am, Sir,
Your obedient servant,
O. C. Armstrong,
President.

December 19th, 1921.

THE DUNDEE SYSTEM OF HEAVY-DUTY HOUSE WIRING.

Major H. Richardson, electrical engineer to the Corporation of Dundee, who is one of the most prominent supporters of reform in methods of charging for electricity, hold also that in the lay-out and erection of " all-electric " house installations the methods of wiring on the multiple distribution or central distribution systems, generally used are much too costly and cumbersome, if it is the intention to use electricity for heating and cooking purposes or for any of the other uses to which it may be put. " All-electric " houses, so far as the wiring goes, would appear to be an effort to reinforce the walls of the house by means of cables, or conduit, culminating in long rows of distribution fuses fitted in glass cases, in perhaps three or four parts of the house, and finishing up at the meter with elaborate porcelain handle fuses and d.p. main switches needing only a switchboard attendant for operation and maintenance to complete the picture.

We have only to watch our gas competitors pipe and fit up a similar house to realise that if electricity is to make any headway at all existing methods of wiring must be altered and brought down to the level of the common gas main, run all over the house and tapped off as required for lighting, cooking, or heating. Gas has all along offered a single medium for lighting, heating and cooking, and electricity can now do likewise through the introduction of the multi-part tariff, so far as the rates of charge are concerned.

With this purpose in view the Dundee Corporation Electricity Supply Department recently drew up a special lay-out in wiring and fitted up a seven-roomed house, including the usual scullery, kitchen, and bathroom. Briefly, the method of wiring adopted is as follows (it being assumed that a bulk supply is being given on the two-part rate of charge for all purposes) :—Metallic-sheathed surface wiring is used throughout. From the street service connection, at which point there is the usual d.p. switch and fuses, a main twin cable of suitable capacity (not less than 7/.029) is taken round the passages, landings or corridors of each floor of the house. Depending on the style, shape, and size of the house, it may often be possible to run one " arterial " main for the whole building and later, if necessary, make a " ring " main of it. The main cables are kept at the height of the architraves of the doors, all possible advantage, of course, being taken of existing mouldings to hide the presence of the cable, to which any of the present day surface wiring systems admirably lend themselves. Over each doorway is placed a d.p. porcelain bridge fuseboard (see fig. 1), comprising two bridge fuses (of not less than 25-A capacity) into which the " arterial " main is looped as it runs from doorway to doorway. From each set of fuses another " arterial " main (not less than 3/.036) is run round each room at about the height of the door or picture-rail, and can, if required, also be completed as a " ring " main. From these auxiliary mains and fuses controlling the respective rooms are then taken the necessary lamp leads and heating and cooking plugs. The lighting of the living rooms and bedrooms has been carried out by bracket fittings on the walls (figs. 2 and 3), the whole of the lights and power plugs in the respective rooms being controlled by a s.p. master switch placed at a convenient height on the wall at the door. Each bracket is given a projection of about 18 in., and is fitted with an inverted type shade giving an indirect effect from the ceiling. An extra switch lampholder is shown fitted to the elbow of some of the brackets, for connecting up small auxiliary apparatus, such as kettles, toasters, irons, &c., but in practice these were not found satisfactory, and it has been decided to substitute a two-pin 5-A socket and plug mounted on the base block of the bracket light. Each bracket light has a switch lampholder fitted with " chain-pull " action. It should be the endeavour to place these bracket fittings from 2 ft. to 2 ft. 6 in. from the ceiling, and they should be placed on opposite walls in equal numbers, depending on the size of the room to be lit. The wall sockets and plugs with the control switches are brought down and fixed on the wall within easy reach (generally at a height of 4 ft. 6 in.) at whichever part of the room the heating or cooking apparatus is required. As a rule, the lighting brackets are kept at about the height of the main wire running round the room.

The chief advantages claimed for such a method of wiring are that there is always at hand a heavy main to each room, which can be conveniently and easily tapped for extensions; fusing devices are cut down to a minimum; separate systems and central distribution boards are unnecessary; expensive ceiling fittings or electroliers are done away with; a complete installation for lighting, heating, and cooking can be carried out quickly and expeditiously in houses at present using other methods, without a great deal of preliminary work and with a minimum of trouble and annoyance to the tenant; and the installation can be added to with ease on the rare occasions when this would be necessary.

It might, of course, be argued that switching has been reduced much below requirements, and that the installation generally is crude and old-fashioned, being laid out somewhat on the lines of the old " tree " distribution system. To a certain degree that may be so, but the average house installation is generally only fitted up to meet existing needs; consequently, when it is the wish to add one or two radiators or a small cooking stove, the wiremen have to be called in to run a special circuit right back to the service connection, the existing installation in nearly every case being much too weak to carry any of the present day apparatus for heating and cooking.

Fig. 1.—The Hall, showing d.p. Fuses Over Doorways.

Fig. 2.—The Drawing Room, showing Inverted Reflector.

Fig. 3.—A Bedroom. Bowl-fire Plugged into Switch-base.

RAILWAY ELECTRIFICATION.

By Sir VINCENT L. RAVEN, K.B.E., M.Inst.C.E., M.I.Mech.E.

(*Abstract of Paper read before the* North-East Coast Institution of Engineers and Shipbuilders.)

This paper deals in a general way with some of the advantages which may result from the substitution of electric for steam locomotive operation. Taken as a whole, it will be shown that the advantages can all show a definite financial economy in operating expenses.

The mechanical disadvantages of the steam locomotive may be briefly summarised as follows:—

The locomotive being a complete independent unit, its power cannot be greater than the capacity of the boiler.

To increase the boiler capacity obviously implies increased dimensions and weight, both of which offer grave difficulties with regard to clearances and strengthening of bridge structures.

It is known that on many railways in Britain the limit of weight has been reached, and further development of power is only possible at enormous expense.

The boiler, cylinders, valve gear, crankshafts, and all reciprocating parts are costly to maintain. Turntables, fueling plant, and water supply appliances must be provided.

The cab is small and open to the weather, involving discomfort to the locomotive crew.

The locomotive radiates heat and uses coal all the time steam is up, that is, during many hours when it is doing no work, and either standing by or coasting.

The wear and tear of the locomotive on the track is considerably increased by the impossibility of accurately balancing the reciprocating parts.

The electric locomotive is not hampered by any of the above-mentioned objections. In addition, it possesses other important qualifications, such as:—

Simplicity of mechanical construction and operation.

Increased power of acceleration.

Higher scheduled speed due to the possibility of heavy short-period overloads resulting in more frequent service and increased use of existing tracks. Uniform turning effort resulting in a better factor of adhesion at starting and on gradients.

Absence of all reciprocating movement and accurate balance of all rotating parts.

Facilities for driving from either end of a locomotive.

Accessibility of mechanical and electrical parts.

Better accommodation for locomotive crew by reason of increased cab area, and by closing in and heating the cab.

Possibility of coupling two or more locomotives together under the control of a single driver.

One essential difference in operation between an electric and a steam locomotive, where the former can show a very definite advantage, lies in the preparation and setting-by of the locomotive.

An electric locomotive is always available for service at a moment's notice, since the electric motors only require that they should be kept clean, lubricated, and provided with brushes in order that they may be always ready for immediate use by simply connecting them to the distribution line. In order to start up an electric locomotive which is standing, the driver only has to step on board, close certain switches, and move the controller handle. When the day's work is over, nothing has to be done except ordinary examination, oiling, and cleaning for next trip.

On the other hand, the process of preparing a steam engine for duty involves considerable time and labour. About three hours before the driver and fireman come on duty, the steam raiser has to make up and light the fire and attend to it until the driver takes charge, after which it takes the driver and fireman about sixty minutes to complete the preparation of the engine for its day's work. While the engine is at work, water and coal have to be taken, and very often the fire has to be cleaned and made up.

After the day's work is finished, the fire has to be thrown out and fire-bars cleaned, smoke-box ashes to be thrown out of the smoke-box, and the tubes have to be cleaned by compressed air. The top of the brick-arch has to be cleaned down and the brick-arch itself has to be renewed frequently. About every sixth trip, the boiler washer has to clean the boiler to keep it fit for producing steam. The boilersmith has to examine and renew the lead plugs, and attend to leaky tubes and many of the other small repairs to the boiler in order to enable the engine to run its stipulated mileage. The shed fitters have a large number of working parts to keep in order which have no corresponding part on an electric locomotive.

Then again, when the electric locomotive has been put into service it can remain at work continuously for at least twenty hours in every twenty-four, as the lubrication and the small amount of cleaning necessary for the electrical equipment can be given by the crew at wayside stops, during running and between trips.

It may be contended that the driver will be fully occupied during running in, watching signals, and controlling speed, and will not be able to attend to these small items; but it must be remembered that, although a second man is not required in the operation of an electric locomotive, it has so far not been usual to allow one-man operation. This means that the second man in the cab will have plenty of opportunity to attend to cleaning and inspection of all parts where this can be done without interfering with the running.

Therefore, an electric locomotive need only go into the sheds in the ordinary way for cleaning and inspection of brake blocks and certain of the less accessible parts between the frame. On the steam engine, however, the boiler, fire, and smoke-box, in addition to the much larger number of mechanical parts, such as cylinders, valves, link motions, &c., are responsible for a considerable amount of time taken up in examination, and attention which might otherwise be utilised for hauling traffic.

Due to these two differences in operation, therefore, namely, preparation for service and ordinary service attention, the electric locomotive can be longer in revenue-earning service than the steam locomotive; thus, provided traffic conditions will permit, the electric on these two counts alone is capable of dealing with a considerably larger ton mileage than the steam locomotive.

Although the electric locomotive may be capable of remaining in service for a longer period of the day than the steam locomotive, it is not possible to obtain the full advantage due to this feature without adopting some system of "pooling." The crew of the electric locomotive cannot remain at work for a longer period owing to present-day regulations. The objections which are made to "pooling" steam engines do not hold good in the case of electric locomotives. The number of adjustments that are required in the case of a steam engine and the fact that a reasonable period must be allowed for making these adjustments between trips, added to the difference in the running made by the care or carelessness of the driver, and the natural disinclination of one man to do those things which another has left undone, add considerably to the difficulties of "pooling" steam engines. On the other hand, due to the simplicity of control, in the case of the electric locomotive, there is no objection to "pooling"; and so full advantage can be taken of their capacity for working longer hours.

In addition to this, since the only requirements of the electric locomotives in the ordinary condition of service consist of cleaning and adjustments carried out in the ordinary routine inspection, it is possible when some occasional derangement of schedule occurs, to keep these engines in continuous service for two or three days, by omitting the cleaning and routine inspection for that period. Such an extension of time in service would not be practicable with steam working. This advantage applies particularly to the case of the electric shunting locomotives, which are frequently kept in service for six days continuously.

On the North-Eastern Railway the result of the Newport and Shildon working between 1914 and 1920 is in accordance with the following statement (nine months' average):—

	1914 (steam).	1920 (electric).
Train miles per train hour	65	8.8
Wagon miles per train mile	44	53
Wagon miles per train engine hour	208	379

The mileage run by the electric engines to-day is 116 train miles per day per engine in traffic, as compared with 55 for the steam engines in 1914.

The fundamental difference between an electric locomotive and a steam engine lies in the fact that while the latter generates its own power, the former is only a transformer of the power which is generated at the power station or stations into haulage power on the track. One consequence of this difference is that the working of a steam engine depends to a large extent on the skill of the crew in attending to the fire and the water level, and in looking after a large number of mechanical parts, and generally nursing the engine so as to get the best out of it. The working and condition of an electric locomotive are not nearly so dependent upon the skill of the driver and his assistant. Full power is always available, and the power and speed which can be developed at any moment are only limited by the initial design of the electrical equipment and by the mechanical construction.

The driver of an electric locomotive need never hesitate to exert the full power for the sake of nursing the locomotive, and all trains within the limit of load for which the locomotive is designed can be hauled up the maximum gradient at full speed. It is evident, too, that the over-load capacity of the generating station or stations will be very much greater than that of a single boiler mounted on a steam locomotive; and since the capacity of an electric motor is in practice only limited by heating effect, it follows that an electric locomotive is capable of a very large overload for a short period. That is to say, that provided the average work performed does not

exceed that for which the locomotive was designed, the work done may, for short periods, be greatly in excess of the average. The result of this is that the speed, when climbing a gradient, can be much greater with an electric locomotive than with a steam locomotive of the same nominal horse-power, because the extra work done by the former is compensated for by the light duty during periods of running on the level and on falling gradients when the motors have time to cool down.

The limitation of boiler capacity in the case of a steam engine combined with the different characteristics of steam and electric locomotives, gives the latter an additional advantage in the question of speed on gradients. As the governing factor in the power of a steam engine is the capacity of the boiler, which is practically a fixed quantity, the horse-power output of the locomotive is approximately constant over a wide range of speed. In other words the maximum pull of an electric locomotive can be maintained until a certain definite pre-arranged speed is attained; whereas a steam locomotive can only exert its maximum pull at the moment of starting, after which the pull is reduced as the speed increases. Thus the speed of the train falls to a marked extent whenever the train has to climb a gradient. This reduction of speed on a gradient is not nearly so marked in the case of the electric locomotive, for there being no similar limitation to the amount of power available, the relation between speed and tractive effort is quite different, and the demand for greater tractive effort is supplied by a higher output from the power supply system. Thus, when determining the initial characteristics of an electric locomotive for a given service, the speed up the ruling gradient can be fixed at any desired value; and since the efficiency is practically constant over a wide range of load, the speed on the level can be maintained at the same value, if desired, without loss of efficiency. In comparison with steam engine working, where the speed is greatly reduced on a gradient, this enables a much higher average speed to be maintained over the whole line; which is equivalent to saying that with electric working the general average speed can be considerably increased without any increase in the maximum speed.

If other factors, such as drawgear and braking facilities permit, this characteristic of electric locomotive operation would allow goods trains to travel at an average speed more nearly approaching that of passenger traffic. The result of this would be a more regular flow of traffic over the line, and the necessity for side-tracking the goods trains to allow passenger trains to pass would be reduced. It is a fact that a higher general average speed of travel increases the total capacity of the line.

In certain cases, owing to this characteristic alone, where a line is being worked at its maximum capacity under steam operation, and is yet unable to deal with the required traffic, a substitution of electric for steam engine working would avoid the necessity for incurring large capital outlay in doubling or quadrupling the track and providing additional passing places, &c., which would have to be undertaken in order to work the traffic without gaining the additional advantage obtained by electrification.

A further advantage which can be obtained owing to this increased average speed of travel is better traffic working. In dealing with the traffic carried a greater number of trains can be run, and these trains complete their journeys in less time than with steam working, thus enabling better use to be made of the available rolling stock. This is particularly true in the case of goods wagons. The percentage increase in the speed will be greater in the case of the goods than in the case of the passenger trains, and so the saving in wagons, due to the increased mileage which wagons will be able to work annually, will be particularly striking.

As an example of the savings which may be effected in certain cases directly due to the advantage of electric locomotive operation as just stated, the following data may be given. These data refer to a length of single track on an existing steam railway. The data have been worked out, as it has now been decided to make a start with the electrification of this section. It should be stated that the case cited is one particularly favourable to electrification, and it must not be assumed that the advantages and gains expected from its electrification could be obtained in other less favourable cases. The length of the line is some 250 miles, mainly single track, and containing in many places exceptionally steep gradients, reverse gradients, and sharp curves.

The total goods traffic under the conditions obtaining in 1918 was some 13,000 tons per day dispatched in the direction of falling grades, but the traffic is rapidly increasing and the estimates are worked out for an assumed traffic 50 per cent. in excess of this. In order to carry this traffic it was estimated by the Railway Company that it would have to make deviations, &c., which practically amounted to providing double track for some 200 miles and building a new line over lighter grades in parts.

Electrification will obviate the greater part of this expenditure. The line as worked under steam conditions is divided up into six sections, and the train load differs for each section. With electric operation this frequent breaking-up of trains would be unnecessary, and the full-weight trains would be hauled right through, without alteration.

This re-organisation was calculated to effect a reduction in the annual train mileage of through goods trains, of about 25 per cent. for the same total ton mileage. At the same time the average speed of travel would be increased, the total time for the double journey being reduced from about 56 hours to 26. The saving in new wagons due to this acceleration of service was estimated to amount to approximately 423 40-ton wagons, or the equivalent.

Partly as a result of the increased average speed and partly as a result of the longer time that electric locomotives can be kept in service as compared with steam engines, a considerable saving can be effected by electrification in the total number of engines that is required to deal with any given volume of traffic. On the Chicago, Milwaukee and St. Paul Railway, 45 electric locomotives have replaced 112 steam locomotives.

Electrification has enabled about 30 per cent. more tonnage to be dealt with in about 80 per cent. of the time formerly required under steam operation, which means an effective increase in the capacity of the line due to electrification of 32.5 per cent.

Due to its uniform turning efforts, the electric locomotive has a further advantage when starting trains. In the case of the electric engine the increase of the effort at starting above the normal effort is greater than in the case of the steam engine, and can be kept up for a longer time. For example, take the case of the passenger locomotive whose average or continuous rating is 1,400 b.h.p. If such an electric engine started with a pull of 17 tons, it could maintain this pull up to a speed of 45 m.p.h. At this point the b.h.p. exerted is about 1,900. If necessary when accelerating up a steep grade, this locomotive can produce as much as 3,000 b.h.p.

The result of this is that trains started by electric locomotives can get away quicker than if started by steam engines of equivalent average rating. The advantage of this is chiefly apparent in the case of stopping passenger trains, when by increasing the acceleration, the average speed can be considerably raised, and goods trains when starting from intermediate stations, and especially when coming out of refuge sidings after a passenger train has passed. If an electric engine stands for an hour on an up grade there is no reduction in its maximum pull. When a steam engine stands for some time the cylinders are cooled, and the engine cannot exert its maximum pull until they are heated to about the temperature of the entering steam. It has been observed that this reduction of pull due to cool cylinders is as much as 25 per cent.

As there is no necessity for taking in water for electric locomotives—with the exception of the small quantity that may be required to steam-heat existing passenger stock in certain cases—it is unnecessary to provide either water columns or troughs on lines designed for electric operation. Similarly, there is no need to provide coaling stations, coaling plant or ashpits for electric operation. When an existing line changes over from steam to electric working, the delays caused by taking in water or fuel and raking out ashes are eliminated. Again, electric locomotives are designed for double end driving, and there is no need for turntables or the delays in turning engines; thus in these items, time can again be saved and added to the useful working time that the engine is in service. Further, because the electric locomotive requires no attention whatever whilst lying by, a saving can be effected in the crew's time, since it is unnecessary for an electric locomotive to be in charge of the crew while it is lying over. It can be locked and left in a safe place. In the case of a steam engine the time occupied in ineffective locomotive duties is over 25 per cent. of the total enginemen's time.

A very serious disadvantage of steam operation is that the steam engine radiates heat and uses coal all the time that steam is up, that is during many hours when it is doing no work, and either standing by or coasting. On the other hand, the electric locomotive uses no power whatever (except for lighting and heating the cab) unless actually running and doing work. This saving in fuel consumption, rendered possible by the adoption of electric working, is becoming increasingly important as the high price of coal suitable for steam locomotive firing is more and more pronounced. But the main fuel saving which can be introduced by electric operation, is due to the very much more efficient combustion of fuel in power stations, than on individual engines. This is one of the greatest advantages to be obtained by electrification.

On the Chicago, Milwaukee and St. Paul Railway, one unit of electrical energy does the work of between 6 and 7 lb. of coal on steam locomotives. With an up-to-date power station, a unit of electricity is produced with less than 2 lb. of coal.

(To be concluded.)

The British Industries Fair (Birmingham).—There is an entry of 500 exhibitors, and many of the exhibits will be much larger in bulk than previously. On January 1st the work of equipping the three great aerodrome sheds at Castle Bromwich will be commenced. This section of the fair will again be under the joint organisation of the Birmingham Municipality and the Chamber of Commerce. The president is the Lord Mayor of Birmingham, and Mr. H. O. Worrall (Worrall & Co., Ltd., leather manufacturers) is the chairman of the council.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

32,963. "Electromotive drives for calculating machines." Optische Anstalt C. P. Goerz Akt. Ges. December 8th. (Germany, December 11th, 1920.)
32,971. "Variable inductance and transformer coils for wireless circuits and formers therefor." G. H. Moody. December 8th.
32,976. "Oscillation generators." Western Electric Co., Ltd. December 8th. (United States, December 22nd, 1920.)
32,977. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). December 8th.
32,981. "Electrically-operated sound-producing horns for motor vehicles." C. W. Inggs and H. Lucas. December 8th.
32,982. "Incandescent electric lamp holders." J. R. Sibils. December 8th.
32,987. "Connection of windings to commutators in dynamo-electric machines." W. B. Sayers. December 8th.
32,997. "Devices for registering telephone calls." J. Hutcheson and J. Hutcheson & Co. December 8th.
32,999. "High-frequency telephony." Ges. fur Drahtlose Telegraphie and H. Gewecke. December 8th. (Germany, January 26th.)
33,011. "Cross current recooling installations." C. Kohler. December 8th. (Switzerland, December 31st, 1920.)
33,033. "Apparatus for reducing interference of atmospheric, &c., disturbances during the reception of wireless telegraphic signals." J. K. Hele. December 9th.
33,042. "Emergency portable signalling apparatus for mines." T. Hall. December 9th.
33,047. "Railway or tramway rail joints." E. C. Strong. December 9th.
33,051. "Electrical switches and operating gear therefor." W. G. Pipkin and Verity's, Ltd. December 9th.
33,060. "Electric fuse boards." Cable Accessories Co., Ltd., A. Crawford, and F. H. Reeves. December 9th.
33,098. "Electric feeder connectors for contact rails on electric railways." Callender's Cable & Construction Co., Ltd., P. V. Hunter, and J. Mather. December 9th.
33,099. "Supports for electric cables, pipes, &c." Callender's Cable and Construction Co., Ltd., R. A. D. Macalister, and J. S. McCallum. December 9th.
33,119. "Means for mounting and driving magneto-electric machines." J. White. December 9th.
33,121. Sparking plug." J. E. Temple. December 9th.
33,128. "Multi-pole sparking plug." F. L. Eldridge. December 9th.
33,129. "Machine switching telephone exchange systems." Coventry Automatic Telephones, Ltd. (F. R. McBerty) and Peel-Conner Telephone Works (McBerty). December 9th.
33,132. "Process for increasing frequency." H. Sefton-Jones (Lorenz Akt. Ges.). December 9th.
33,135. "Apparatus for production of high-tension unidirectional electric currents." H. E. Donnithorne. December 9th.
33,137. "Electric heating systems." G. E. Fox and H. G. Hayes. December 9th.
33,151. "Apparatus for electrically precipitating suspended particles from fluids." Siemens Schuckertwerke. December 9th. (Germany, January 14th.)
33,153. "Electricity meters." W. Cross (Mordey). December 9th.
33,154. "Appliances for electric arc welding." A. P. Strohmenger. December 9th.
33,160. "Transformers." E. Vedovelli. December 9th.
33,171. "Apparatus for electrically precipitating suspended particles from fluids." Siemens Schuckertwerke. December 9th. (Germany, June 28th.)
33,196. "Electrical flooder and tell tale for carburettors of internal-combustion engines." T. Cockerill. December 10th.
33,218. "Boards for charging torch accumulators." W. E. Pollard. December 10th.
33,221. "Electrically-heated kettle, &c." A. L. Large. December 10th.
33,239. "Intermittently operating electrically actuated devices." Magneta Time Co., Ltd., and A. B. Webber. December 10th.
33,284. "Combination couplings for electric conductors." L. M. Waterhouse. December 12th.
33,288. "Electrolytic rectifiers." H. W. Richards. December 12th.
33,306. "Process for manufacture of commutators for electric generators and motors." A. Oates. December 12th.
33,349. "Drying means for electric mechanical pocket, &c., lamps." A. O. French-Brewster. December 12th.
33,353. "Means for obtaining telephonic modulation of high-frequency oscillations." C. E. Prince. December 12th.
33,354. "Oil-brake switch with resistance." Maschinenfabrik Oerlikon. December 12th. (Switzerland, December 10th, 1920.)
33,369. "Interrupter for metal-vapour apparatus ignited by high-tension impulses." J. C. Pole. December 12th. (Austria, December 11th, 1920.)
33,372. "Electrically-operated clocks." C. F. Johnston. December 12th.
33,386. "High-tension condensers." E. Pfiffner. December 12th. (Germany, January 5th.)
33,404. "Cutting-device for travelling threads or filaments." W. Pool and Vickers, Ltd. December 12th.
33,419. "Aerials for wireless signalling." H. T. Ellis. December 13th.
33,420. "Magneto-electric devices." R. Bosch Akt-Ges. December 13th. (Germany, December 13th, 1920.)
33,422. "Electric switches." R. H. Hancock and G. A. Russell. December 13th.
33,424. "Electric lighting plants for motor-vehicles, &c." E. B. Collingham & C. J. A. Owen. December 13th.
33,428. "Earthing metal-sheathed insulated wires and cables for electric wiring systems." F. J. Clarke. December 13th.
33,434. "Device for locking electric-lamp bulbs to sockets." H. F. D. Jacob. December 13th.
33,435. "Electric switches." C. C. Garrard, A. E. McColl & A. H. Railing. December 13th.
33,442. "Electric resistances." L. E. Hopkins. December 13th.
33,445. "Numbering-machine for telephone calls." C. Paul. December 13th.
33,466. "Auto transformer." A. Della Riccia. December 13th. (Germany, December 14th, 1920.)
33,470. "Automatic electric cut-outs or interrupters." L. Kahn. December 13th. (Germany, December 13th, 1920.)
33,473. "Electro-magnetic wave-receiving and amplifying systems." F. J. Chambers. December 13th.
33,476. "Electric clocks, time recorders, &c." J. W. Miles & J. S. Powell. December 13th.
33,490. "High-temperature electric furnaces." Westinghouse Lamp Co. December 13th. (United States, December 13th, 1920.)
33,533. "Insulator for high-pressure electric lines." A. Renaudin. December 13th. (France, December 15th, 1920.)
33,534. "Electrical measuring of sounds or mechanical vibrations." J. R. Barden & Hoffmann Manufacturing Co. December 13th.
33,536. "Cleaning or regenerating plates of accumulators." R. G. Reid. December 13th.
33,549. "Thermionic valve relays." E. Pollock. December 13th.
33,550. "Valves for controlling supply of current to anode of valve of continuous wave transmitter." A. Onwood. December 14th.
33,556. "Slip rings for electrical generators." R. Bosch Akt.-Ges. December 14th. (Germany, December 20th, 1920.)
33,559. "Telephone call counting, registering, and recording apparatus, &c." T. G. Anderson and G. H. Huntsworth. December 14th.
33,561. "Means for unlocking magnetically-locked lamps." J. Davies and [illegible] (Derby), Ltd., & C. Dawson. December 14th.
33,567. "Electric heating of tools of edge-setting, &c., machines." British United Shoe Machinery Co., Ltd. (United Shoe Machinery Corporation). December 14th.
33,569. "Model electric motor." L. Mynne. December 14th.
33,580. "Connections for electric cables, &c." E. W. Hill. December 14th.
33,591. "Electric traction motors." J. W. Hanson. December 14th.
33,614. "Apparatus for registering telephone calls." D. Rosen. December 14th.
33,619. "Means for preventing removal, &c., of electric lamps, &c., from their sockets." A. S. Dorsey. December 14th.
33,634. "Coin-collecting means for telephones." F. W. Hall. December 14th.
33,635. "Meter registers and control devices for telephones." F. W. Hall. December 14th.
33,647. "Electric-motor control systems." Westinghouse Electric and Manufacturing Co. December 14th. (United States, December 14th, 1920.)
33,649. "Incandescent lamps." British Thomson-Houston Co., Ltd. December 14th. (United States, January 18th.)
33,654. "Electrical connecting-devices and lamp-holders." C. J. Marsollier. December 14th.
33,657. "Armatures of electrical machines." G. H. Fletcher & Metropolitan-Vickers Electrical Co., Ltd. December 14th.
33,663. "Electrical device for destroying rats." D. Marshall. December 14th.
33,701. "Safety vents for electric motor cases, switchboxes, junction boxes, &c." F. W. Close and Electric Construction Co., Ltd. December 15th.
33,706. "Marking and identifying conductors of multi-conductor electric cables, &c." E. T. Williams. December 15th.
33,717. "Electric resistances." R. Amberton. December 15th.
33,726. "Thermo-dynamic apparatus." J. F. J. Malone. December 15th.
33,731. "Ignition coil and sparking plug tester." I. Buckley. December 15th.
33,744. "Bringing into and out of electric circuit an inductive resistance or choke." W. Langdon-Davies and A. Soames. December 15th.
33,747. "Electric drive for talking-machines." F. C. Ker & A. McGregor. December 15th.
33,762. "Apparatus for localisation of faults in cables and insulated conductors." V. Planer. December 15th. (Germany, December 3rd.)
33,779. "Electric fuses." W. Clark. December 15th.
33,785. "Fusible devices for protecting electric circuits." Metropolitan-Vickers Electrical Co., Ltd. December 15th. (United States, January 25th.)
33,791. "Thermionic generators." H. J. Round. December 15th.
33,792. "Electrical adaptors, plugs, &c." A. E. Morgan and J. Saynor. December 15th.
33,796. "Electric lamps." J. W. Jones & Thor Electric Safety Lamp Co., Ltd. December 15th.
33,807. "Electric couplings." W. J. Lovell & S. B. Pratley. December 15th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

14,093. "Electric heaters for heating liquids." E. C. R. Marks (Langguth and Haar). May 21st, 1920. (172,096.)
15,075. "Electro-magnetic relays." Creed & Co., Ltd., & T. Lenaghan. June 3rd, 1920. (172,041.)
18,277. "Automatic switch for distant control." L. L. E. Chauveau. April 3rd, 1919. (146,336.)
22,084. "Electric current regulating devices." W. H. Glaser & W. H. Glaser, Ltd. July 23rd, 1920. (Cognate application 23,650/20.) (172,055.)
23,126. "Sparking-plugs for internal-combustion engines." L. Grillette. August 6th, 1920. (172,069.)
24,439. "Apparatus for utilising the energy of waves." A. Beldimano. August 23rd, 1920. (172,078.)
24,593. "Electrically-driven motor wheels for automobiles and other road vehicles." G. A. Bishop & R. A. Chadwick. August 25th, 1920. (172,088.)
24,654. "Insulating chain for electric transport lines." E. L. Gely. August 25th, 1920. (172,091.)
24,835. "Electric discharge lamps." H. Filippo, D. Lely, Jun., & Naamloose Vennootschap Philips' Gloeilampenfabricken. August 27th, 1919. (150,692.)
24,839. "Electric arc-welding systems." Wilson Welder & Metals Co., Inc. June 26th, 1920. (165,760.)
24,975. "Electric switches and enclosure boxes therefor." Simplex Conduits, Ltd., & H. F. McLoughlin. August 30th, 1920. (172,102.)
25,029. "Electric water-heater." R. J. Frost. August 30th, 1920. (172,104.)
25,033. "Telegraphic-receiving and transmitting apparatus." E. C. R. Marks (J. A. L. Horn). August 30th, 1920. (172,105.)
25,125. "Means for limiting change of speed in alternating-current generators." T. F. Wall. August 31st, 1920. (Cognate application 13,971/21.) (172,112.)
25,264. "Stopping or slowing of electric motors." E. M. Medway, E. C. Smith, & A. S. Medway. September 1st, 1920. (172,122.)
25,390. "Valve transmitters and receivers for wireless telegraphy and telephony." A. K. Macrorie, H. Morris-Airey, and G. Shearing. September 2nd, 1920. (172,127.)
25,464. "Automatic electric sub-station systems." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric & Manufacturing Co.). September 3rd, 1920. (172,131.)
25,977. "Electrolytic rectifier cell." J. Kremenezky (firm of). March 14th, 1918. (150,958.)
26,419. "Electrical turning-gear for starting internal-combustion engines." F. H. Royce. September 15th, 1920. (172,153.)
27,339. "Starting and lighting systems for use on motor vehicles." Soc. Anon. des Anciens Etablissements Hotchkiss et Cie. and H. M. Ainsworth. September 25th, 1920. (172,167.)
27,558. "Electrical switchgear." D. R. Davies & Metropolitan-Vickers Electrical Co., Ltd. September 28th, 1920. (172,170.)
29,085. "Sparking-plugs." A. J. H. Elverson. October 14th, 1920. (172,185.)
29,189. "Automatic and semi-automatic telephone instruments." Siemens Bros., Ltd., & A. Siemens. October 15th, 1920. (172,186.)
29,383. "Electric indicator boards and the like." E. G. Eriksson & K. G. Jonasson. October 18th, 1920. (172,187.)
29,891. "Sparking-plugs." O. Meissner. June 11th, 1920. (164,705.)
30,135. "Electrically-driven planers and the like." L. Miller & Metropolitan-Vickers Electrical Co., Ltd. October 25th, 1920. (172,192.)
34,847. "Attachment or fastening-device for supporting gas and electrical fittings, pendants, and the like." G. H. Tonks. December 10th, 1920. (172,223.)

1921.

1,422. "Braking-systems for electrically-driven vehicles." British Thomson-Houston Co., Ltd. March 25th, 1918. (157,721.)
6,452. "Electrolytic device for increasing the speed of ships." E. Duteil. March 16th, 1920. (160,459.)
11,121. "Arrangement of neutral point resistances for electric high-tension transmission systems." Allmanna Svenska Elektriska Aktieoblaget. April 16th, 1920. (161,955.)
17,399. "Electro-magnetic wave-receiving arrangements." Soc. Francaise Radio-Electrique. November 3rd, 1916. (Dividend application on 146,204.) (165,426.)
29,491. "Incandescent electric lamps." E. A. Hallwood. August 25th, 1920. (Divided application on 24,597/20.) (172,267.)

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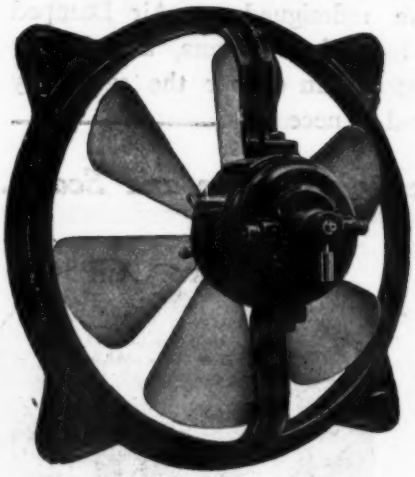

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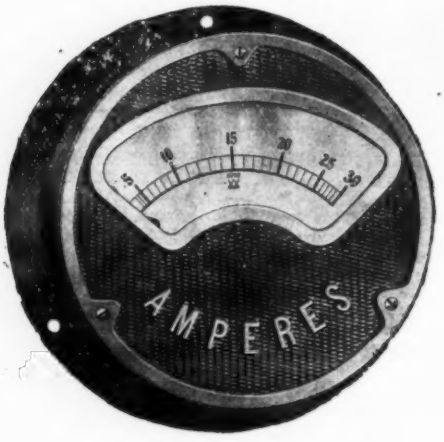

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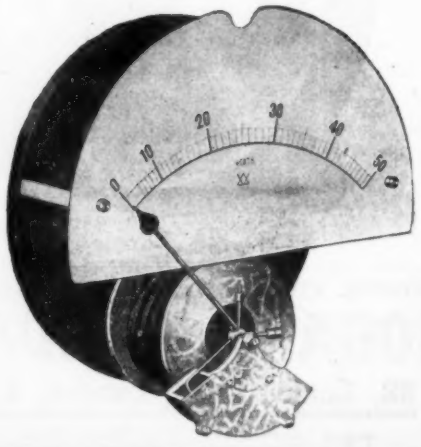

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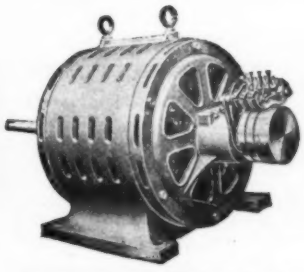
BRITTAIN  MOTOR

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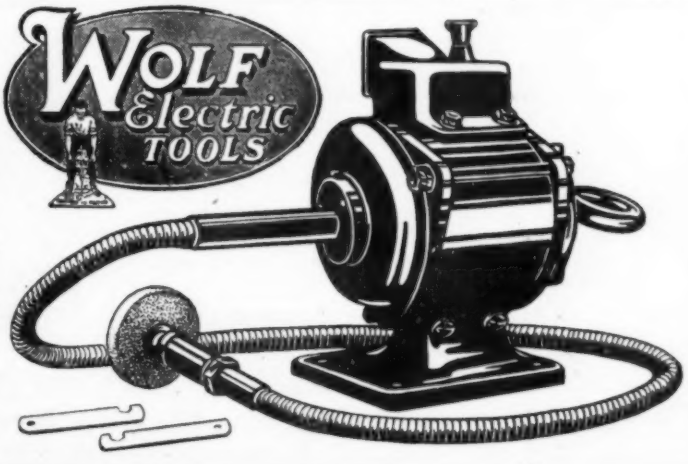

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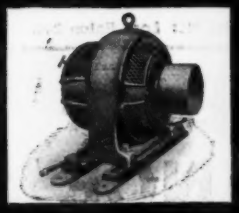

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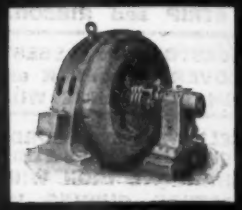

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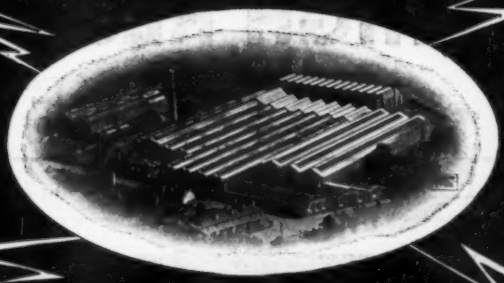

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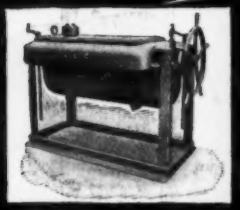

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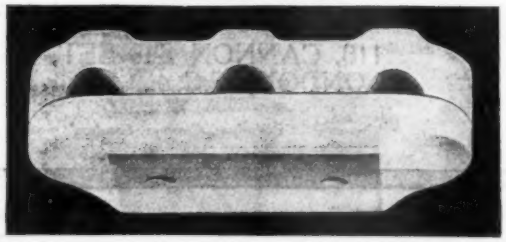

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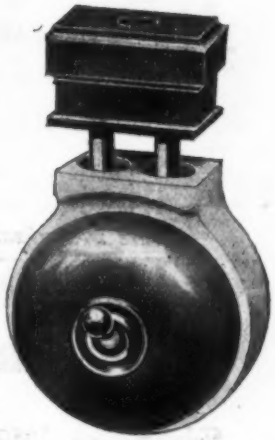

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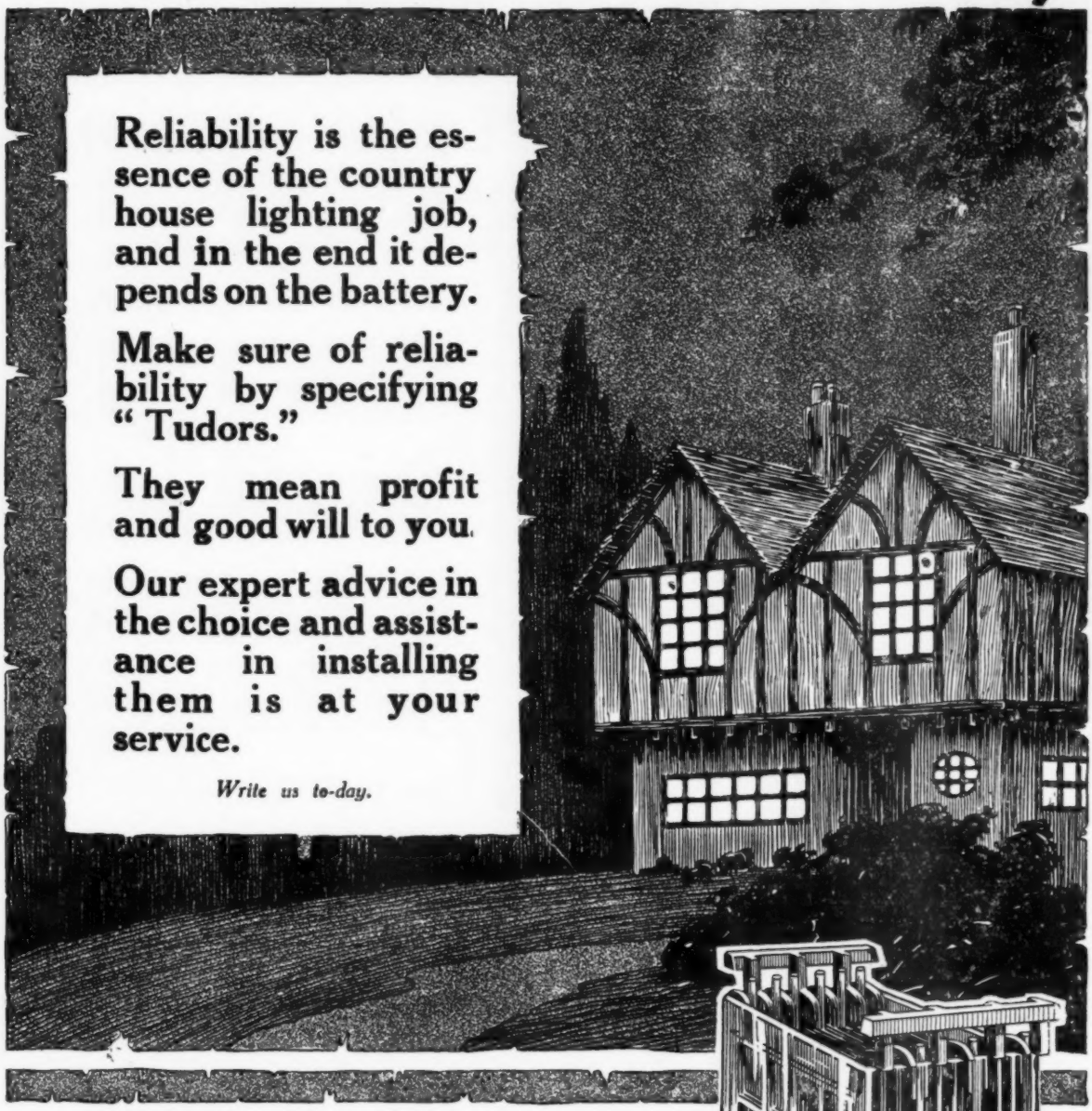

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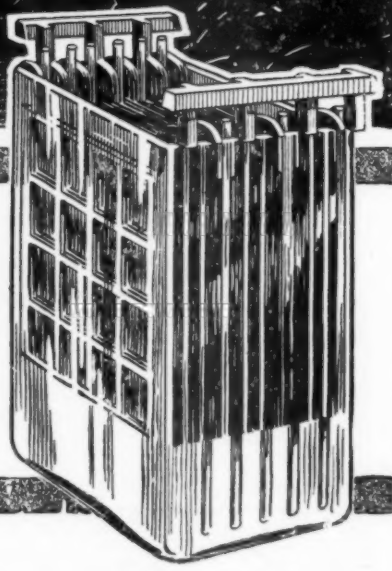

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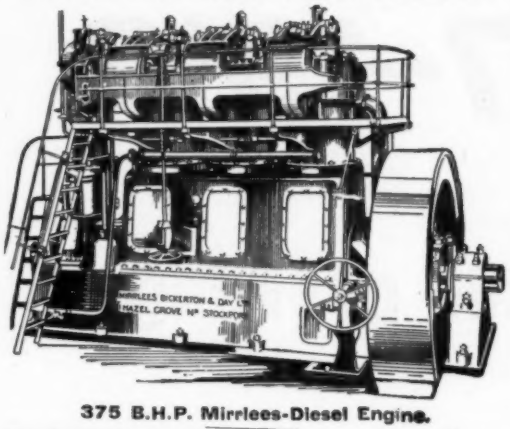

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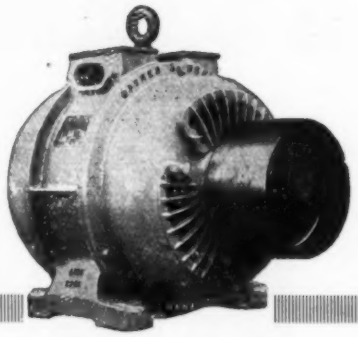
Stores: - - - - „ 5456.

NETTLEFOLD & SONS LTD.
54 HIGH HOLBORN
LONDON W.C.1.



Polyphase Motors.

Squirrel-cage and slip-ring types, all standard voltages and cycles.

½ to 50 Horse-power.

Good stocks and quick deliveries.

We guarantee our Motors and Apparatus installed in the United Kingdom against BREAKDOWN for 12 months from date of invoice. If during that period repairs are necessary we undertake to carry these out free of charge, provided that such machines have been properly erected, and suitably protected against undue overloading, and that the damage does not arise out of wilful neglect, fire, flood, or ordinary wear and tear, but if a breakdown results from wear and tear we will make good the damage to the machine. It is understood that the motor or parts of same requiring repair shall be returned to our Works carriage paid. We do not hold ourselves responsible for repairs made or attempted to be made without our sanction.

This Guarantee is limited to the original purchaser, and is subject to our Representatives having access to the motor for the purpose of inspection at all reasonable times during the period of Guarantee.

Marshall & Plumtree, Ltd.,

20, High Holborn, London, W.C. 1.

Telephone: Chancery 7144.

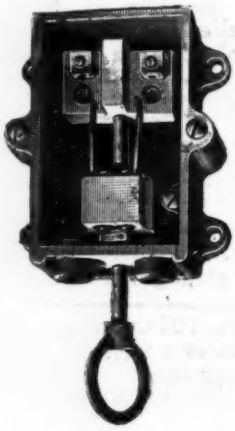
ELECTRIC RADIATORS.

New Lists Now Ready.

REDUCED PRICES.

MANY NEW DESIGNS.

SOUTHERN ELECTRIC Co., Ltd.,
138, Southwark Street,
LONDON, S.E. 1.

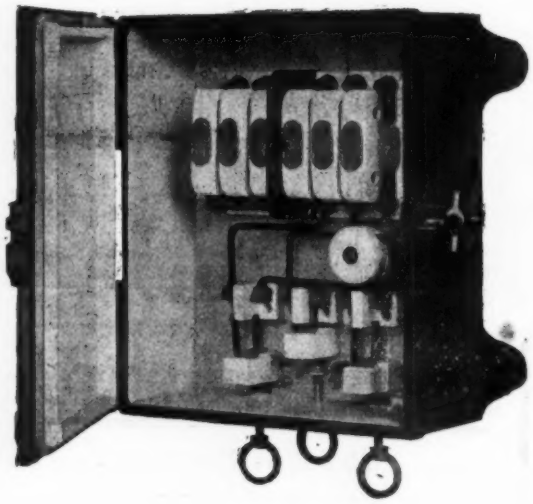


D. & S. "M" TYPE SWITCH.

1897–1918

Of age but still growing.

Increasing sales for over twenty-one years not only show that the design is right, and up-to-date all the time, but also indicate what is even more important, that the workmanship is sound and that the switches stand the rough handling for which they are intended.

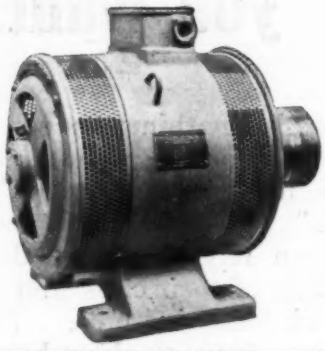


M

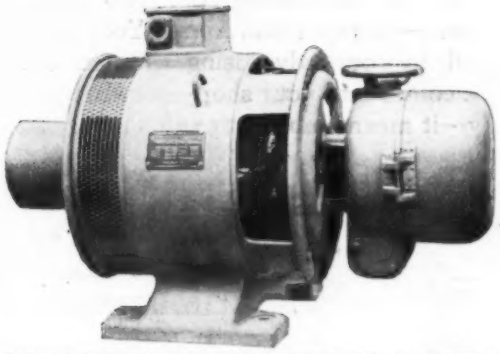
DORMAN & SMITH LTD.,

ORDSAL ELECTRICAL WORKS, SALFORD, MANCHESTER.
LONDON OFFICE: 17, VICTORIA ST., WESTMINSTER, S.W.1.

INDUSTRIAL ELECTRIC MOTORS.



THREE-PHASE SQUIRREL CAGE INDUCTION MOTOR, CLASS A.G. ENCLOSED VENTILATED TYPE.



THREE-PHASE SLIP-RING INDUCTION MOTOR, CLASS A.G.S. PROTECTED TYPE.
FITTED WITH SHORT-CIRCUITING AND BRUSH-LIFTING DEVICE.

DIRECT CURRENT MOTOR CLASS C.B., ENCLOSED VENTILATED TYPE.

"English Electric" Motors combine all the latest developments in electrical and mechanical design and are the product of the amalgamated experience of the various works of the Company.

A wide range of types has been designed, and we are therefore in the unique position of being able to supply machines suitable for all industrial purposes.

Should you require advice as to the type or size of motor that will best meet your requirements, the experience of our engineering staff is at your service.

Standard sizes ready for immediate delivery.

THE ENGLISH ELECTRIC COMPANY, LIMITED.

WORKS:
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QUEEN'S HOUSE, KINGSWAY, LONDON, W.C. 2.

TELEPHONE: HOLBORN 830. TELEGRAMS: "ENELECTICO, WESTCENT, LONDON."

B

Duncan Watson & Co.,

Electrical Engineers,

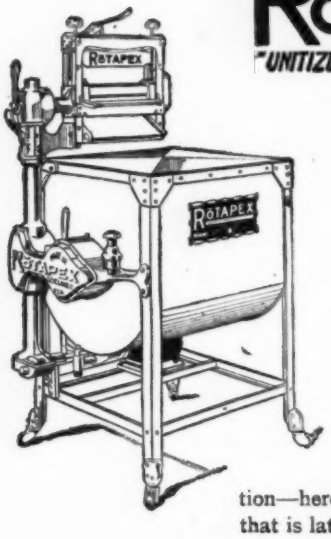
61/62, Berners St., London, W. 1.

Established Quarter of a Century.

HOUSEWIVES who take pride in the cleanliness of their home will thank you for introducing the two home labour savers—Rotapex and Apex. Your sales are helped by our advertising. When the housewife comes into your shop—see that you are ready—it means money to you.

The ROTAPEX

"UNITIZED" ELECTRIC WASHER



ROTAPEX is the electric washer that revolutionises home washing. A *real* washer that doesn't have to be coaxed — shorn of all the complications associated with mechanical washers. The housewife *can* use it and *will* use it when she sees the simplicity of it. As to construction—here again is expressed all that is latest and best.

There's business for you in Rotapex, too.

APEX — the better suction cleaner—has strong claims on the house-proud woman who knows how clean the home should be. Light, portable, constructed on sane, simple lines, there is no better cleaner, and the housewife knows it. Show it to her — *sell* it to her. But first examine Apex construction yourself. You will know then that your sale will be easy.

There's money in Apex for you — ask us how.

The Apex

ELECTRIC SUCTION CLEANER

Both Rotapex and Apex can be seen any time at our showrooms—you can send your clients, too, Your interests are protected.

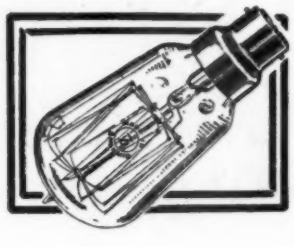
Ask also about Econo and Santo Vacuum Cleaners.

What you want at the price you want.

There is one thing you can always depend upon getting when dealing with us, and that is a "square deal." Whatever it is you order you can rely on the goods being the best of their class and quoted at rock bottom figures. The man we cater for is the keen buyer, the expert purchaser who very properly desires to buy in the best market, and who knows "quality" when he sees it.

To such we issue a cordial invitation for enquiries. Our Stores have been enlarged, and carrying as we do, ample stocks of Z Drawn Wire Lamps (and other makes), Electrolux Cleaners, &c., we can despatch promptly.

We have introduced a novel type of indirect bowl fitting. This is translucent, and can be supplied to resemble plain or coloured marble. It is light, strong, and cheap. You should call and see it.



Z Electric Lamp & Supplies Co., Ltd.,

73, Newman Street, London, W. 1.

Telephone: Museum 4650/1.

Telegrams: "Zedellam, Phone, London."

BRANCHES:

BIRMINGHAM: 8, Church St., Colmore Row.
BRISTOL: 59, Victoria Street.
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ARE MAKERS OF

WATER LEVEL—
INDICATING,
RECORDING and
ALARM APPARATUS

For RESERVOIRS, FILTER BEDS and IMPOUNDING TANKS.

SEWAGE AND STREAM RECORDERS
Mechanically or Electrically Operated.

ELECTRICAL—
FOR SHOWING AT A DISTANCE.

MECHANICAL—
FOR WORKING LOCALLY.

Pen and Ink and a Postcard bring full details.

ALL STURDY INSTRUMENTS.
SUITABLE FOR TRANSPORT.

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FACTORY:—Faraday Works, LEICESTER.
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ELECTRICALLY-OPERATED
SPEED INDICATORS
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ELLIOTT BROTHERS (LONDON) LIMITED
1 CENTRAL BUILDINGS
WESTMINSTER · LONDON S.W.1.
Est. 1800

They save Space.

For durability, economy, reliable working, and above all, for steady light—instal

"HINDLEY" . .
VERTICAL GAS
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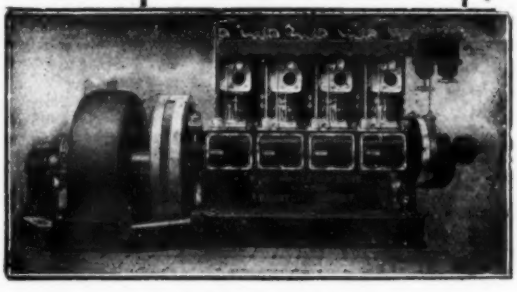

Made in units up to 250 KW.

For Direct-Coupling to Electric Generators.

Also VERTICAL HIGH-SPEED STEAM ENGINES.

LET US SEND YOU FULL PARTICULARS.

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TELEPHONE: CITY 9804.

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Have you considered these facts as applying to some of the apparatus or parts you use?

WELDED WORK

We can guarantee a sound job at strictly competitive prices, and can handle articles from a few pounds up to 10 tons.

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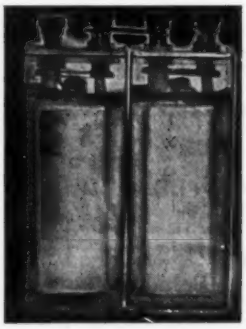

FULLER BLOCK TYPE ACCUMULATORS.

SURPLUS GOVERNMENT STOCK. ABSOLUTELY NEW.

CONSIDERABLY BELOW COST.

Only a limited quantity of our original stock of 26,400 left. Send your enquiries before it is too late. This offer cannot be repeated when present stock is sold. Unobtainable elsewhere at our price.

These Accumulators have no plates to buckle. Internal short-circuiting is impossible. Will hold their charge for months.

LIBERAL DISCOUNT TO THE TRADE.

4-volt, 20 amp.-hour (actual) Celluloid cases only.

AS SUPPLIED TO:—

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The Isle of Wight Electric Light & Power Co., Ltd.
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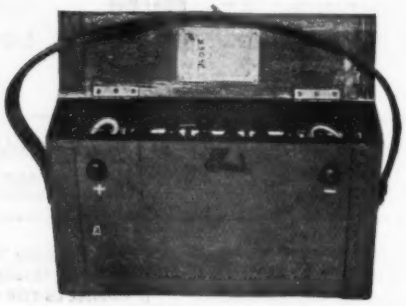
And most of the Leading Houses in the Electrical Trades.

6-volt, 20 amp.-hour (actual). Supplied with or without Teak Outer Cases.

"The Autocar," July 26th, 1920, gave an unsolicited article referring to our remarkable offer to supply the finest Accumulator on the market at a price unheard of before, and recommended owners of cars, who are desirous of equipping their cars with an efficient lighting set at a bargain price, to communicate with us at once. A detailed and instructive scheme of wiring these cells in parallel, together with diagram, was given. We have had this article reprinted.

LET US SEND YOU A COPY.

The 6-Volt and 10-volt sets are supplied with strong Teak Cases, fitted with outside terminals (as per illustration), brass hinges and fastener and solid leather straps.



10-volt, 20 amp.-hour (actual).

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The CITY ACCUMULATOR Co.,

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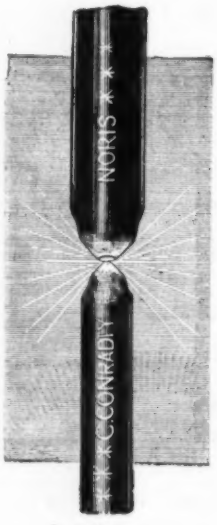
'Phone: 1338 Clerkenwell.



Conradty's CARBONS

LONG-BURNING, STEADY-BURNING.

For Arc Lighting, Cinematograph and Searchlight Work.

In buying Conradty's Carbons you can rely on

(1) Reliability and Uniform Quality.

(2) Prompt Delivery.

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Branches:

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EDINBURGH: 79, 81 & 85, Hanover Street.

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APEX IRONCLAD WATERTIGHT SWITCH & FUSE

GLASGOW PATTERN

Knife Switch operated by the exclusive APEX quick make and quick break movement on four contacts. The possibility of destructive arcing is reduced to a minimum. A particularly useful and reliable model.

Fuses are Porcelain replacement Home Office Type.

Type No. 501.—D.P. or T.P. as illustrated, 30, 60 and 100 amps., 500 volts.

Type No. 401.—D.P. or T.P. Switch only, 30, 60 and 100 amps., 500 volts.

APEX

Right through

the complete series of Apex Switch Gear —the perfected Apex movement is used. Every Apex ***must*** operate correctly—quite independently of the user. Carelessness of the grossest kind cannot prevent it functioning either to the "on" or to the "off" position rapidly and effectively. There cannot possibly be any intermediate position; and then all contacts are broken or made simultaneously—which means that risk of arcing is reduced to the minimum.

"APEX" IRONCLAD SWITCHGEAR

Take an opportunity of inspecting any Apex Switch—note the sweet, smooth silkiness with which contact is made or broken—try to do something wrong — then note the general excellence of design, construction and workmanship — and you will make Apex your standard for every job requiring an ironclad switch. In addition to the models illustrated, Apex Switches are made in Side Handle type with and without H.O. Fuses, Watertight Switch Fuse, and Mine Type Switch Fuse for fiery mines — all of them ironclad.

Full particulars and prompt delivery of Apex Switchgear from:

FOSTER ENGINEERING CO., Ltd.,
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Telephone: 1800 Wimbledon (three lines).
Telegrams: FOSTERACO. WIMBLE, LONDON.

DOWNES & DAVIES,
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Telephone: Central 5794 and 5473.
Telegrams: UTIS.

THE SUN ELECTRICAL CO., Ltd.,
118-120, Charing Cross Road, London, W.C.2.

Telephone: 7766 Gerrard (four lines).
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DRAKE & GORHAM Wholesale, Ld.
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THE

"Rolls-Royce"

OF ELECTRIC HEATING & COOKING APPARATUS

At

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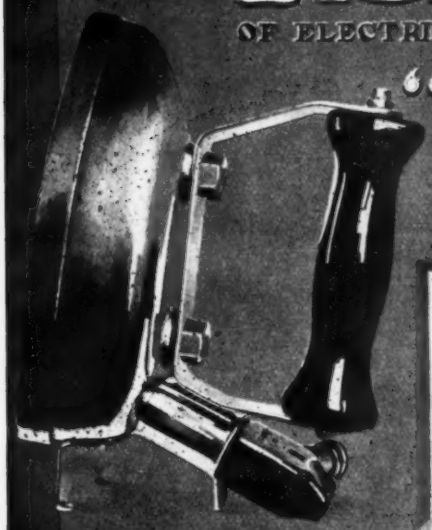

BRITISH INSULATED & HELSBY CABLES Ltd — Manchester, Birmingham, Glasgow, Leeds, Newcastle, Dublin & Belfast.
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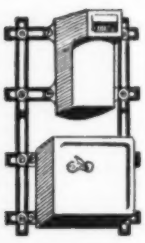
ATM TELEPHONE MANFG. Co

Cheaper than Wood Board for Fixing Frame Construction



MAKES AN ENGINEERING JOB OF YOUR PANELS

WRITE FOR SAMPLES

REDUCE costs by using the Cheaper-than-Wood "WELCO" SLOTTED STEEL BARS for al. Fixing Framework, for all Switch, Meter, Fuse, Service and Starting Panels and for Buildings and Partitions

NO FORGING. NO DRILLING.
NO TAPPING. NO FITTING.

Manufactured in Mild Steel in

CHANNEL BARS.		ANGLE BARS.	
1 in × 1 in. × $\frac{1}{8}$ in. per ft.	9d.	1 in. × 1 in. × $\frac{1}{8}$ in. per ft.	9d.
1¼ in. × 1 in. × $\frac{1}{16}$ in. ..	1/1	1½ in. × 1½ in. × $\frac{1}{8}$ in. ..	1/-
2 in × 1 in. × $\frac{1}{8}$ in. ..	1/6	2 in. × 2 in. × $\frac{1}{8}$ in. ..	1/6

FLAT BARS.

1 in. × $\frac{1}{16}$ in. per ft.	6d.
1½ in. × $\frac{1}{8}$ in. ..	10d.
2 in. × $\frac{1}{8}$ in. ..	1/2

Supplied in Random Lengths, 6–10 ft. Quantities of less than 100 ft., plus 10%, f.o.r. Birmingham.

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STANDARD INSULATOR CO., LTD.
99 & 78a. SALUSBURY ROAD,
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MOULDED INSULATORS
EBONITE or VULCANITE.
HIVOLTSIT or STABALIT.
Perfect Insulation. High Dielectric Strength.
WIRELESS INSULATORS A SPECIALITY.

Belden
***The 100% Efficiency* MAGNET WIRE.**
ENAMELLED. SILK. COTTON.
Silkenamel Cotenamel

VARNISHED INSULATED TUBING
COTTON & SILK.
ALL COLOURS.

SLOT INSULATION
DIELECTRIC STRENGTH, 500 to 700 VOLTS PER MIL.

ASBESTOS COVERED MAGNET WIRES
FIREPROOF. MOISTUREPROOF. ACIDPROOF.

LITZENDRAHT
HIGH FREQUENCY CABLES.
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MOLYBDENUM WIRE
ALL SIZES UP TO 0·01 m/m dia.

PURE PARA TAPE.
FINELY WOVEN ASBESTOS TAPE.

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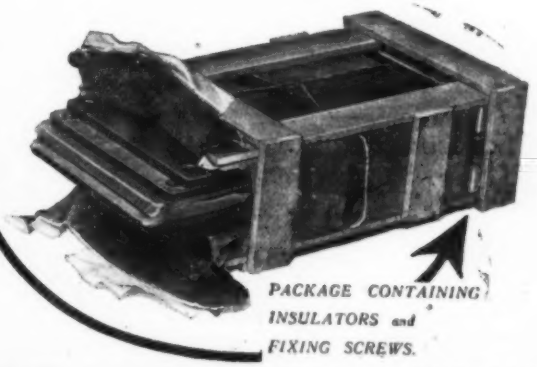
Five-ply Backboards

for mounting
Fuses, Meters, &c.

These are made from the most carefully selected hardwood five-ply boards. They are particularly strong, and owing to their construction, are not liable to warp.

STOCK SIZES (in Inches).			
6 × 9	7 × 11½	9 × 14	11 × 15
11 × 24	12 × 12	12 × 18	13 × 16
13 × 24	15 × 18	15 × 21	18 × 20
18 × 24			

Carefully packed in non-returnable crates containing 10 Boards, 80 Insulators, and 40 2-in. No. 12 Fixing Screws. Easy to stack, and can be given out in a serviceable condition.



PACKAGE CONTAINING INSULATORS and FIXING SCREWS.

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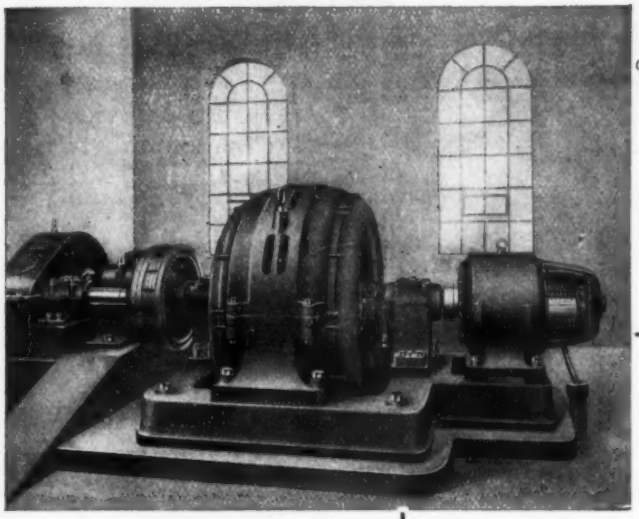

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FOR POWER FACTOR IMPROVEMENT—

The merits of the self-starting synchronous motor are becoming more fully realised.

Such motors start up like ordinary induction motors and pull themselves into synchronism. No skilled attention is required.

They improve the power factor and drive useful load.

FOR 14 YEARS,

THE

"LANCASHIRE"

SELF-STARTING

SYNCHRONOUS MOTOR

has taken a leading part in the development of this class of motor, being the first machine of its type built in this country.

First supplied about 12 years ago, it proved a great success, and many similar motors ranging in size between 50 and 1200 K.V.A. have since been installed for improving power factor whilst at the same time driving :—

Air Compressors,
Blowers,
Fans,
Pumps,
Line Shaftings,
Textile Machinery,

Etc., Etc.

If you are troubled with low power factor, we invite you to consult us. Our wide experience in power factor correction is at your service.

THE LANCASHIRE DYNAMO & MOTOR CO. LTD.
ASSOCIATED WITH
THE CRYPTO ELECTRICAL CO. LTD.

TRAFFORD PARK WORKS, MANCHESTER.

BLISS

"BLISS" Power Presses.

BLISS

Bliss Presses are to be found everywhere. Here is one punching out Pole Pieces, complete, at the rate of 500 an hour at Newcastle-on-Tyne. Don't experiment yourself, but take advantage of our past experiments. Get into touch with us to-day, we can help you.

E. W. BLISS Co., 4, Pocock St., London, S.E.1.
And at 4, Norwich Union Chambers, Birmingham.

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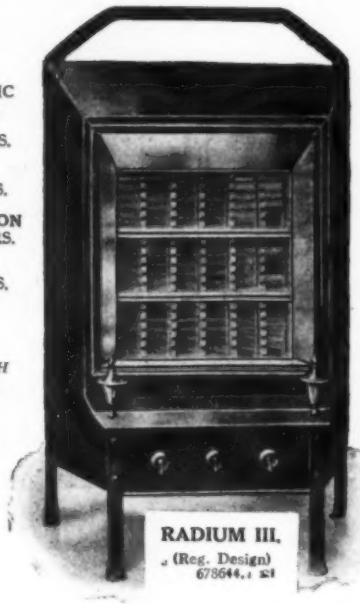
(HEAT-RAY)

ELECTRIC FIRES.
BOILERS.
HOT PLATES.
IMMERSION HEATERS.
FISH FRYERS.
—
BRITISH MADE.



RADIATORS.
GRILLS.
TOASTERS.
FACTORY HEATERS.
GARAGE HEATERS.
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UNIQUE DESIGNS.

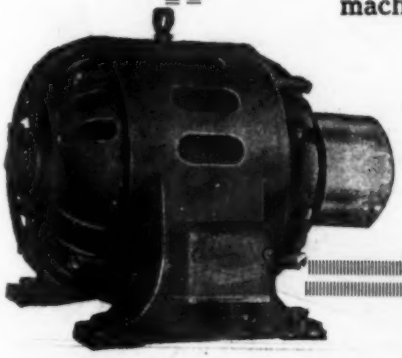
ELECTRIC FIRES, Ltd., NORWICH.

Cheapest to buy, to install & to maintain

If you require an A.C. Motor by all means get a Watt Motor. This is a great advance on ordinary induction motors. It is more efficient. Its chief feature is its high starting torque. Immediately it is switched in full load torque is developed, the starting current being only 50% above normal amperage. In spite of their superiority

Watt Motors

cost less than others. Less to buy, less to install and less to maintain. Starting gear is unnecessary. Only a main switch is wanted. For driving pumps, presses, machine tools, etc., Watt Motors are ideal.



We will be glad to quote you.
Sizes 1—75 H.P. delivered from stock.

Watt Motors Ltd.
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B T-H

Complete

Electrical Equipments

for Every Industry.

The illustration shows a recently completed Curtis Turbo-Alternator—the largest power unit constructed in the United Kingdom—designed and built at the Rugby Works of this Company.

The capacity of this turbo-alternator is :—

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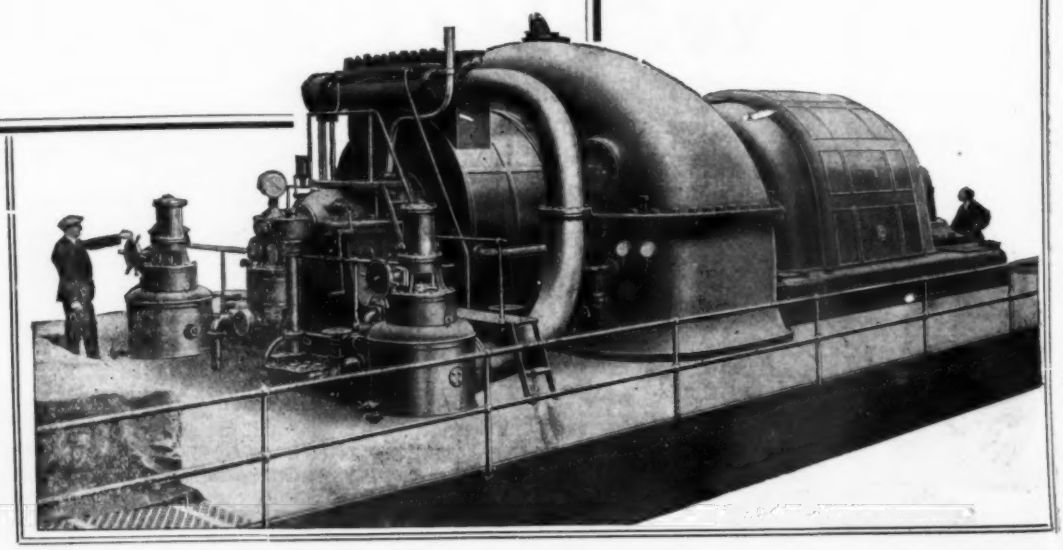

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Our prices are reasonable and we can give ***early*** delivery.

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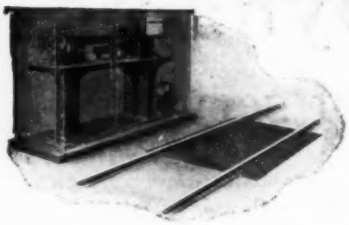

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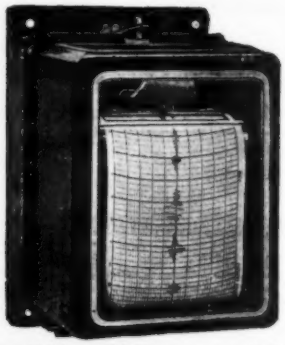
GRAPHIC INSTRUMENTS

For A.C. and D.C. Circuits.



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They embody the latest and most perfect design in Graphic Instruments and their employment gives **GREATER EFFICIENCY.**

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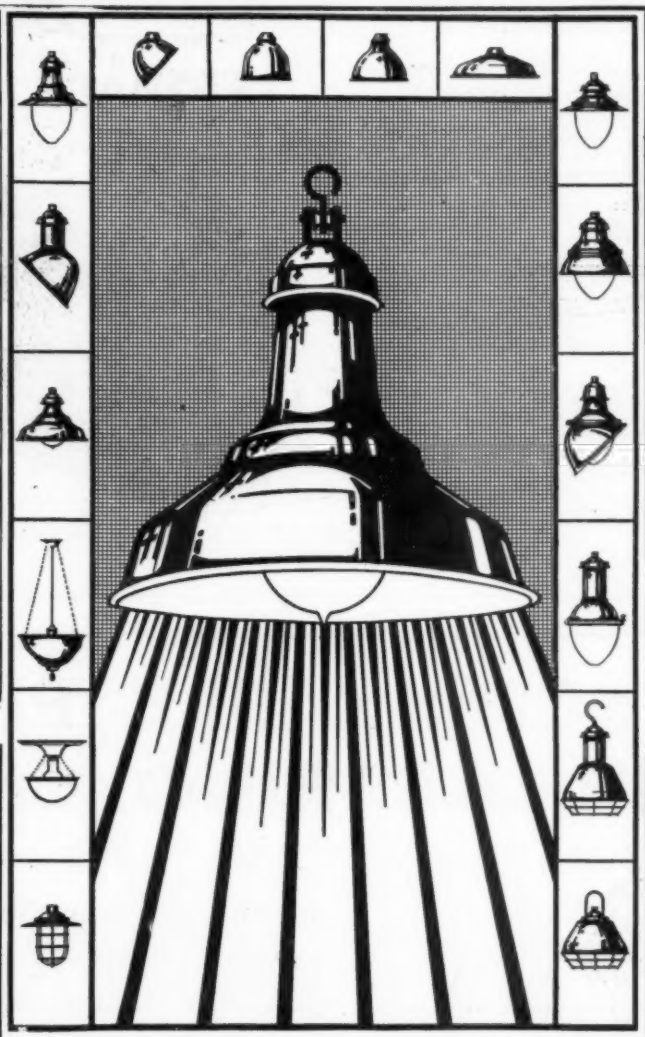

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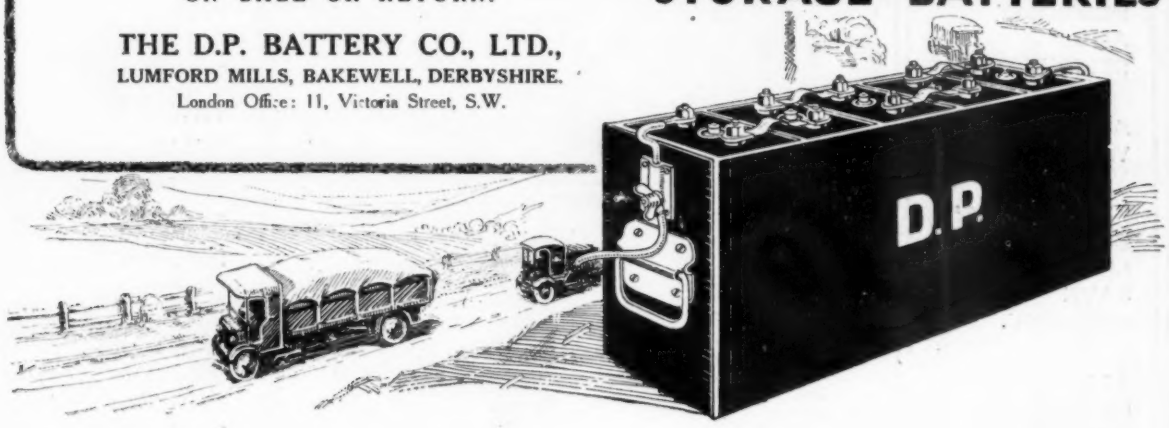

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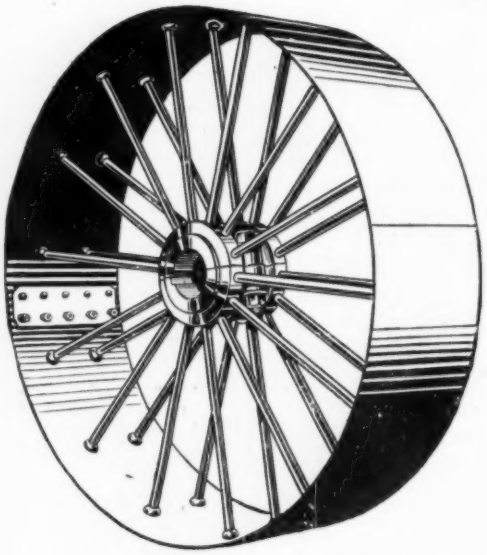

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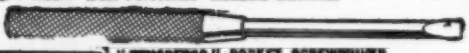

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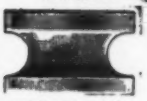

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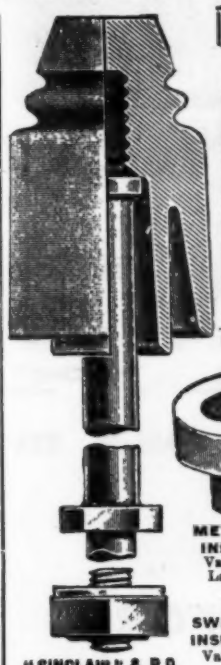

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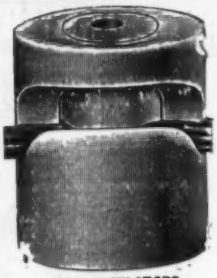

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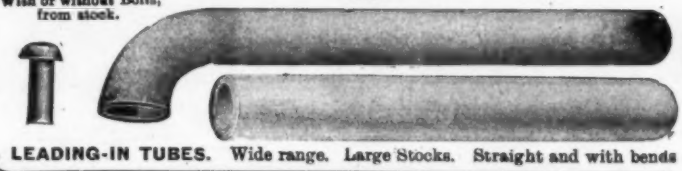

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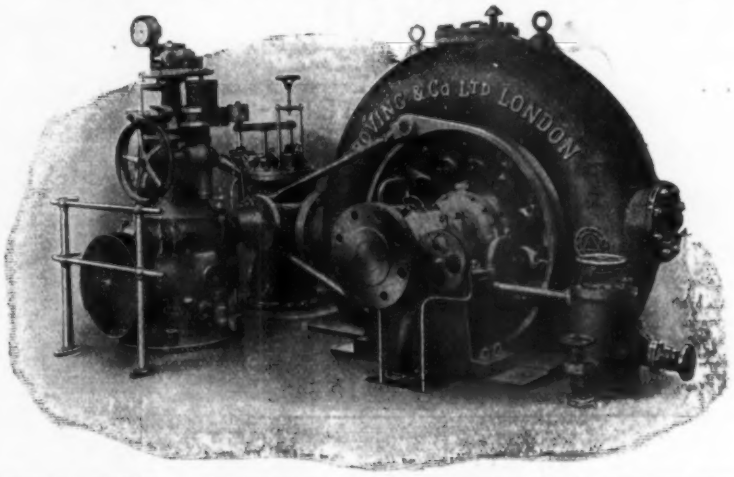

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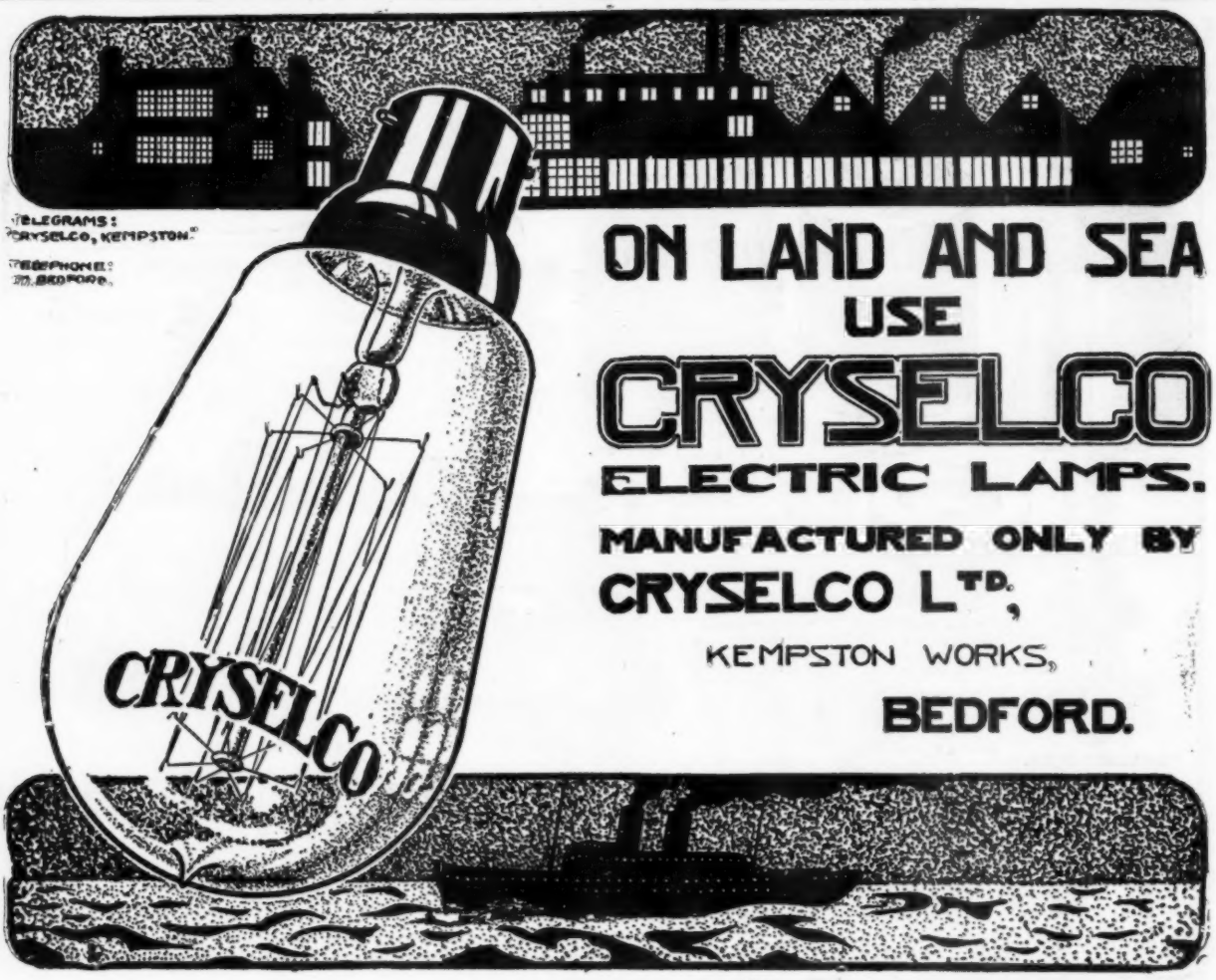

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These Cubicles are easily Transportable, and may be used in all positions where standard Switchboards could not be employed with safety.

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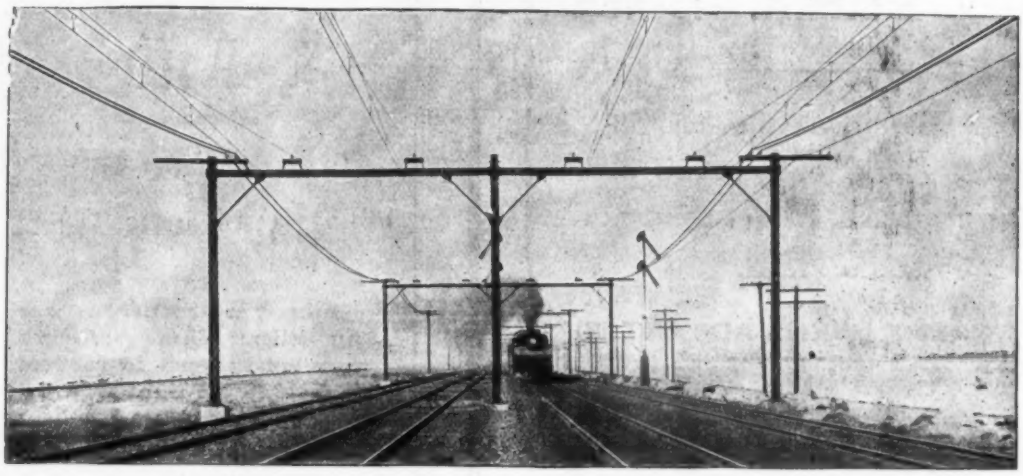

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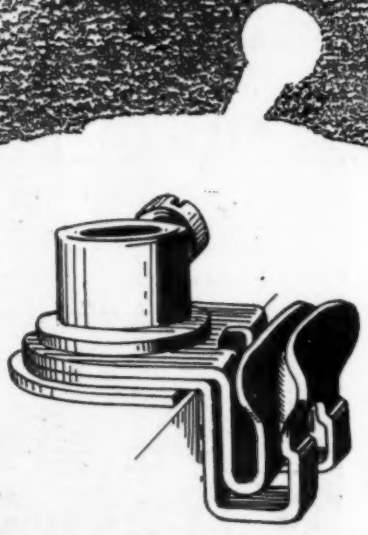

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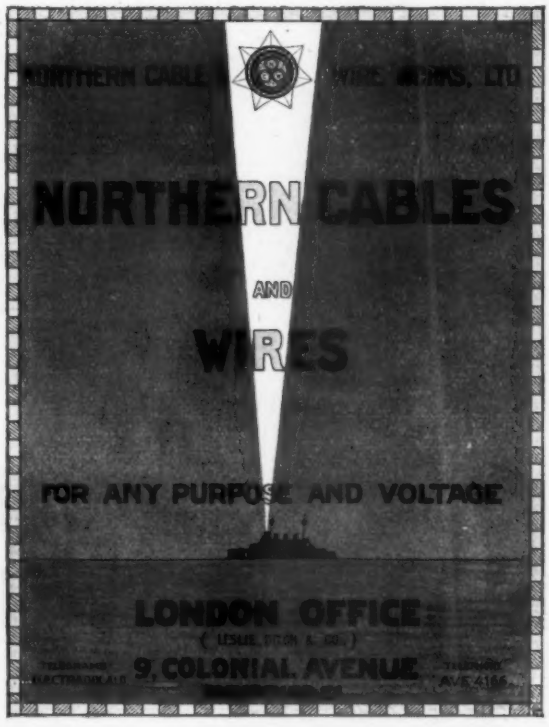

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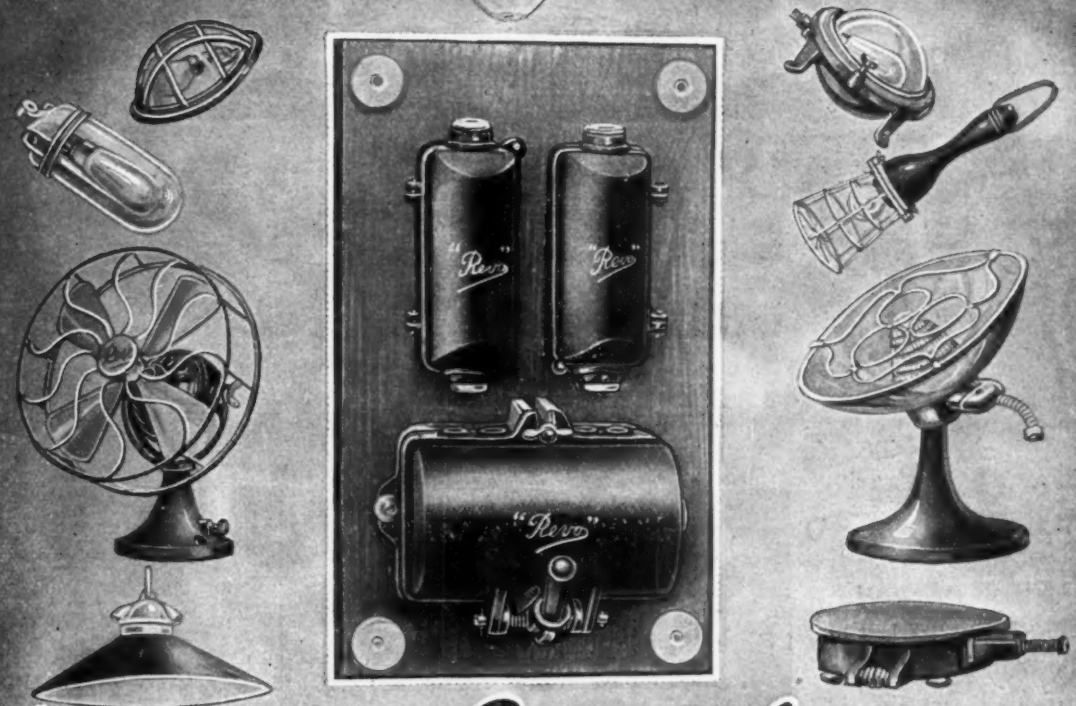
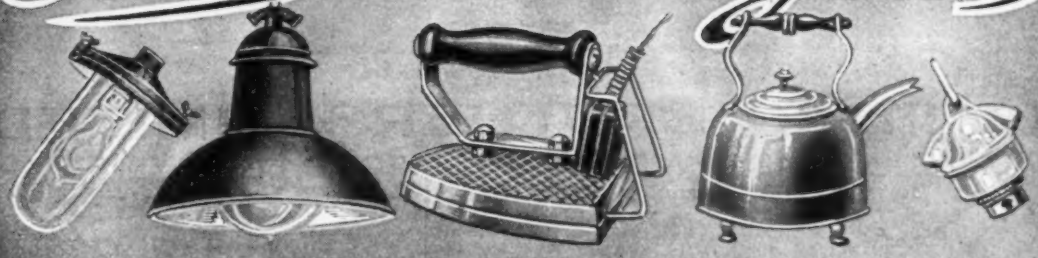


"Revo" Switchgear



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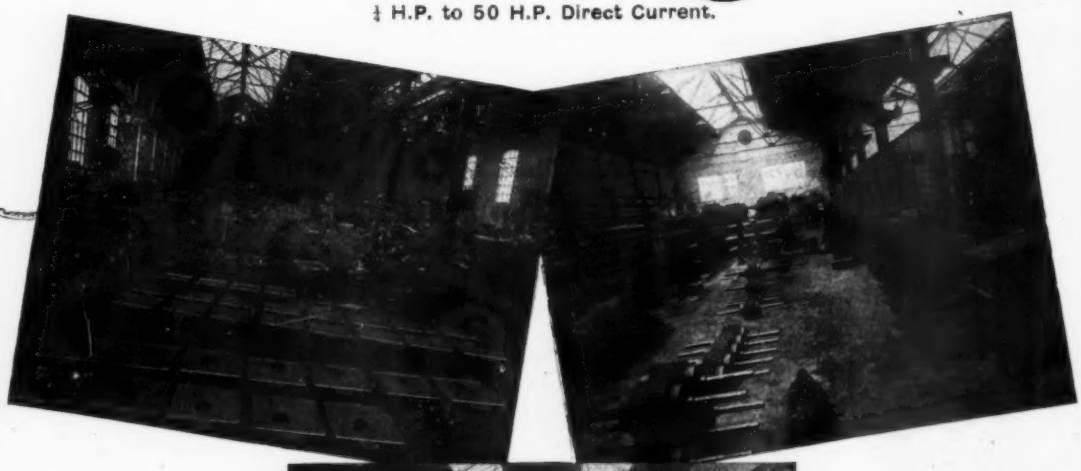

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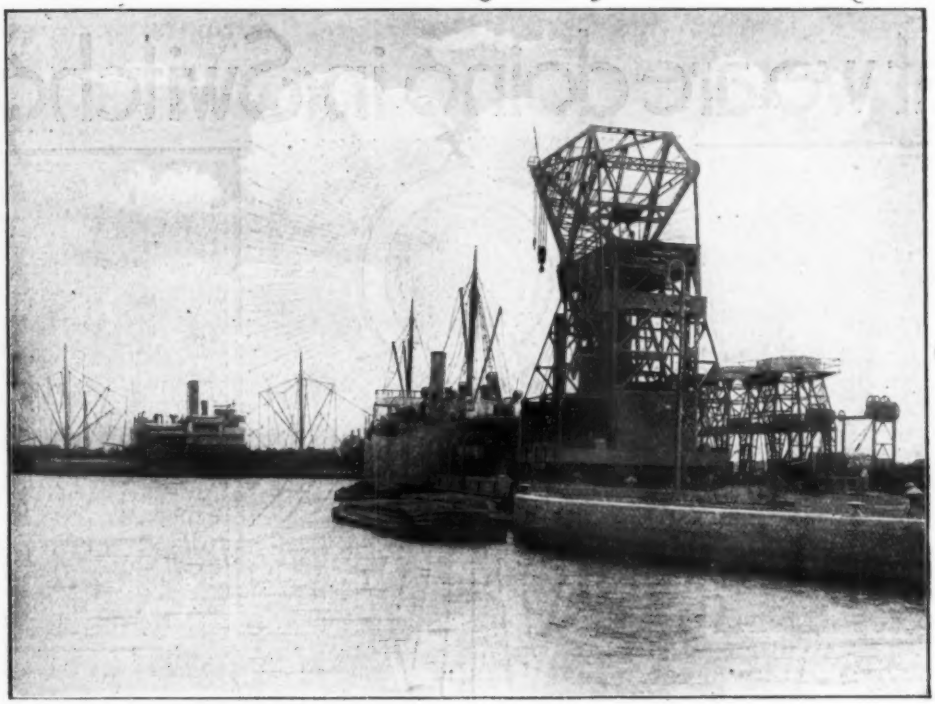

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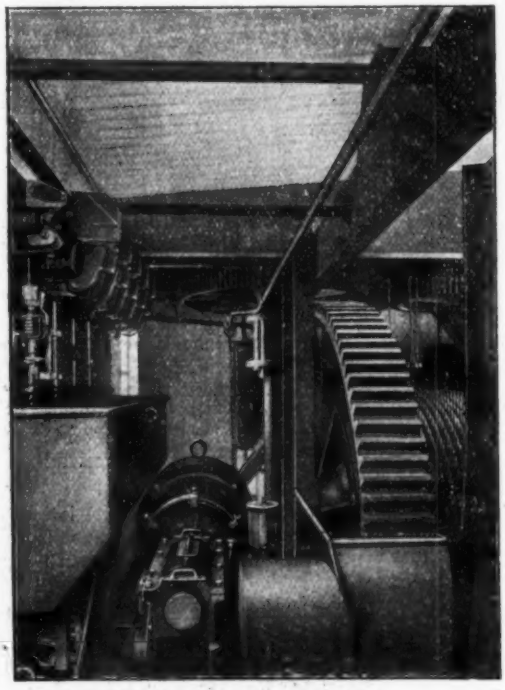

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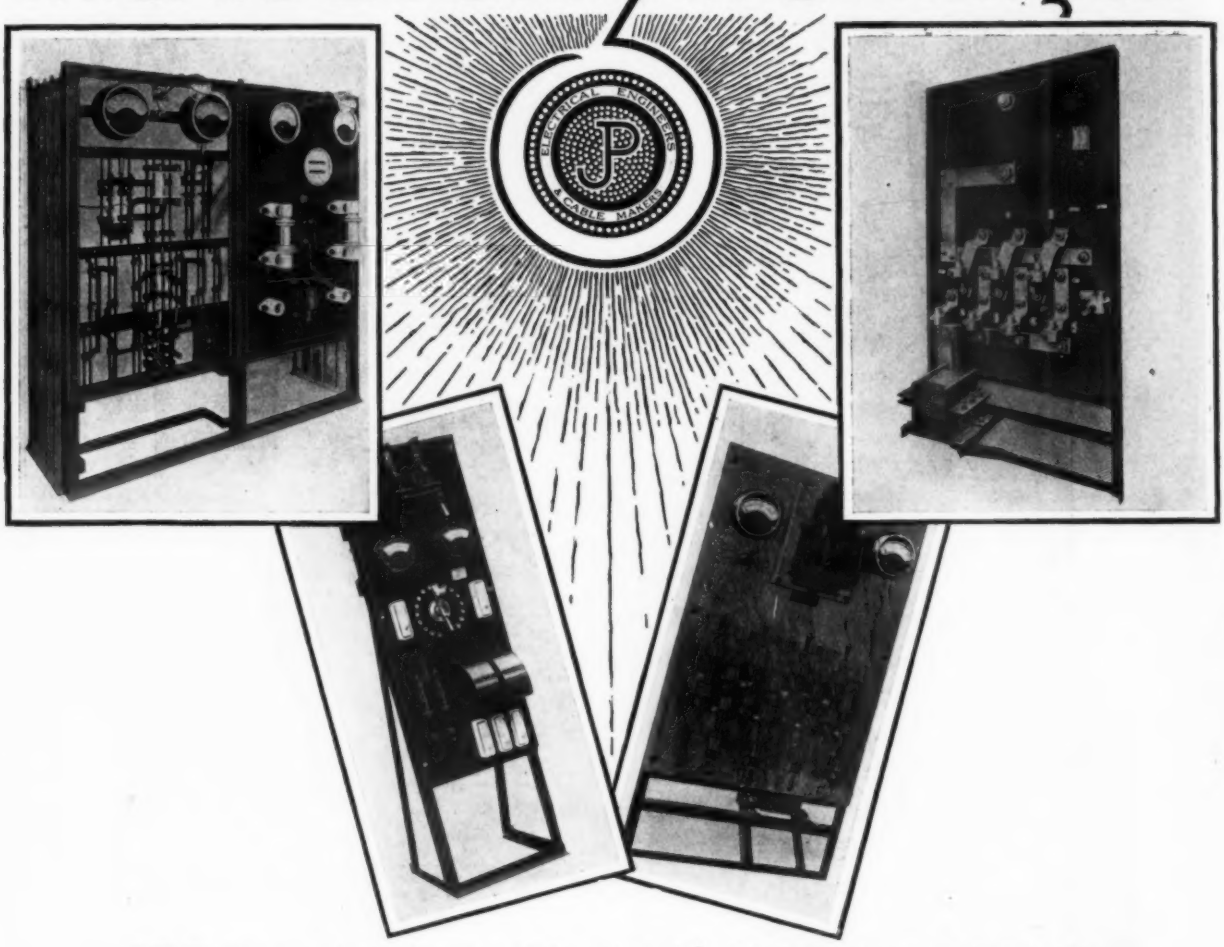
The J&P Pages

What we are doing in Switchgear



WE give some further instances of the variety of conditions and circuits to which the flat-back type of switchboard can be adapted, although (as previously mentioned) its use in this country is considerably restricted by the Home Office Regulations.

Fig. 1 shows a Switchboard of the flat-back type having, however, a steel plate instead of a slate slab for one panel, and for the other, an arrangement of insulated steel bars on which are mounted the live parts of the gear. This board is for the control of the A.C. and D.C. circuits of a wireless installation on board a battleship, slate being dispensed with owing to its liability to fracture when firing is in progress. Although an oil switch is used on the machine panel, overload protection is given by fuses, as the frequency (500 cycles) is too high for the satisfactory operation of overload trip coils.

Fig. 2 shows a single panel for the control of the supply to an extra high tension precipitation transformer with rotary rectifier. Behind the panel is mounted an auto-transformer by means of which, in conjunction with the regulating switch on the front, it is possible to regulate the pressure applied to the terminals of the main step-up transformer.

Fig. 3 and Fig. 4 show the front and back views respectively of a D.C. Board arranged for the series parallel control of four 1,200 ampere 5 volt D.C. Generators for electro-plating work.

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THE SELECTION OF A MOTOR.

(Continued.)

The remaining point to be dealt with is Accessibility.

In a conventionally designed protected type Motor the Yoke is cast either complete with poles, or the poles are inserted separately, the ends are then closed by castings with openings for inspection and ventilation—that at the commutator end carrying the brush gear.

To inspect the windings of these machines without dismantling the end covers and bearings is an impossibility, and it is equally impossible to observe the interior of the machine while running.

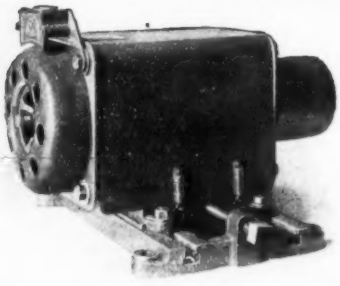
It is desirable in many cases that dust accumulating in a Motor should be blown out at intervals; without dismantling this cannot be accomplished satisfactorily.

The L.W. Motor is completely accessible, the two covers which enclose the whole of the interior of the machine can be removed entirely without any tools. With the aid of only a screw-driver, the brush gear can be removed complete without disturbing the bearings. With the patent design of brush holders the whole of the commutator is visible under running condition.

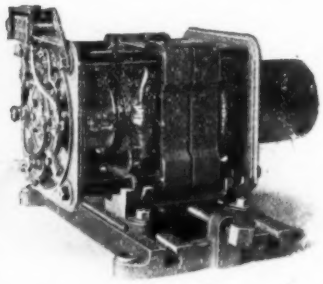
The illustrations below show the protected type machine with and without covers; from these it will be appreciated that facilities are given for inspection under running conditions, which may often prevent breakdowns and thus save great expense in repairs.

Cut this out, and the comple'e series will be found most useful for reference.

L W DYNAMOS & MOTORS



Motor with Covers.



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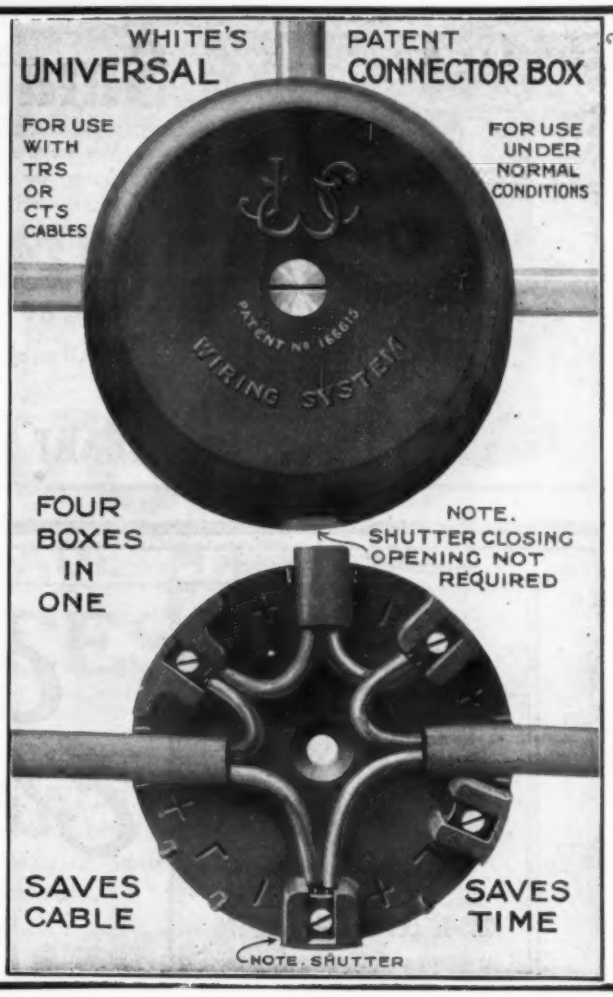

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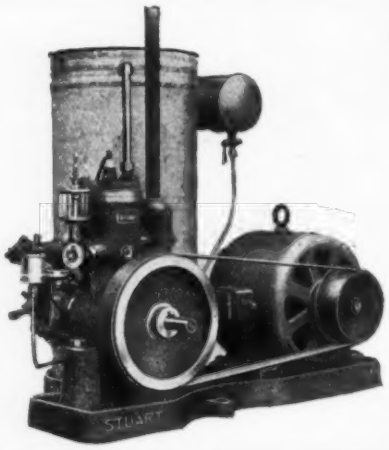

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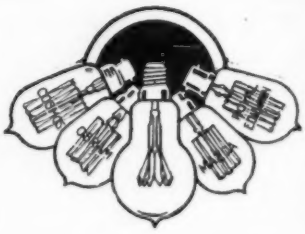

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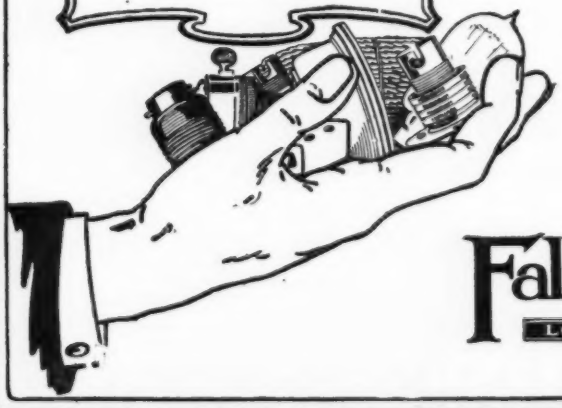

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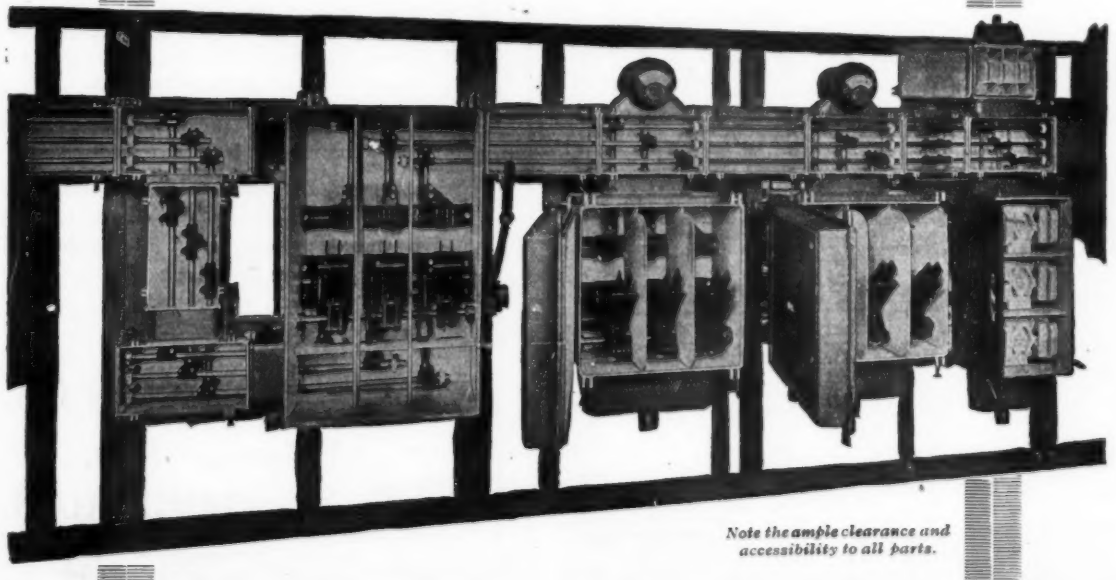

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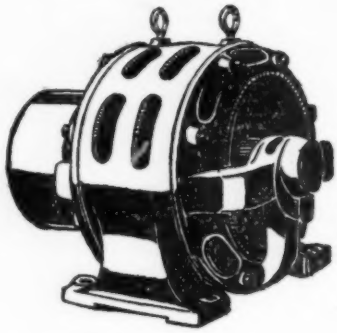

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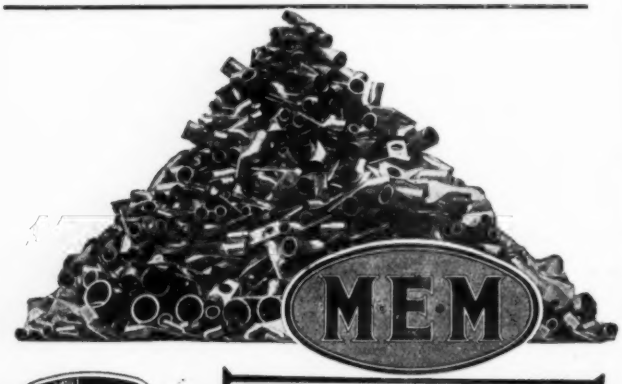

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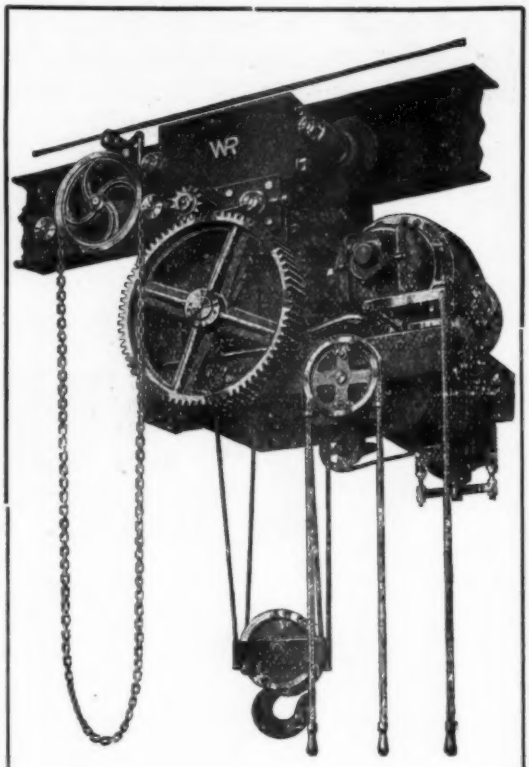

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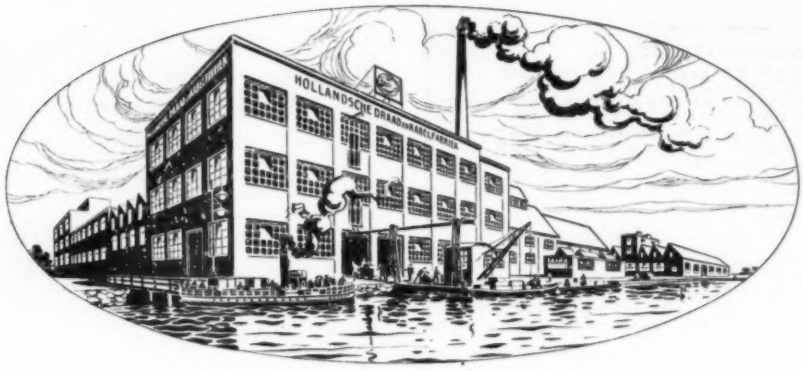

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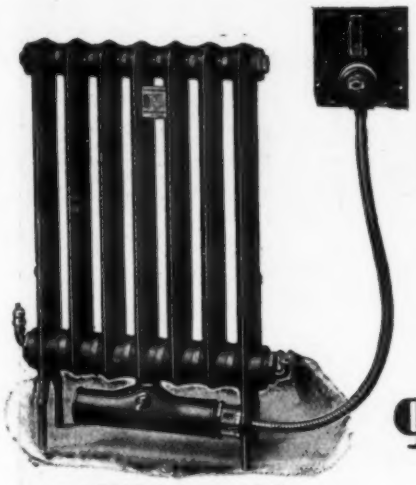

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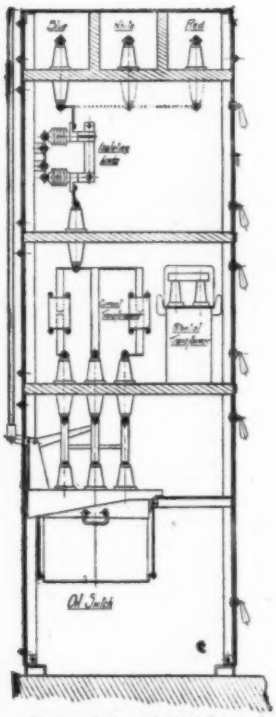
6,600-volt G.E.C. Stonework Cubicles and Operating Board installed in a large Corporation Power Station. In the foreground are two 500-kW G.E.C. Rotary Converters. To the left of operating board, Rotary Converter Switchgear can be seen.



Sectional view of Cubicle.

G.E.C.

Stonework Cubicle Switchboards.

The cubicles are divided into suitable cells so as to isolate the gear to the greatest practicable extent, thus ensuring a maximum of safety.

SPECIALISTS IN HIGH TENSION SWITCHGEAR.

THE GENERAL ELECTRIC CO., LIMITED.

Head Office: MAGNET HOUSE, KINGSWAY, LONDON, W.C.2.

Telephone: Regent 7050 (50 lines). Telegrams: Electricity, Westcent, London.

Branches:—Manchester, Birmingham, Glasgow, Cardiff, Newcastle, Dublin, Belfast, Bristol, Swansea, Liverpool, Leeds, Sheffield, Nottingham, Hull, Southampton, Cork, Aberdeen, Edinburgh, Ipswich, Dundee.

DISPLAYED ADVERTISEMENTS

ADVERTISERS will please note that NEW COPY and ALTERATIONS to Existing Advertisements (with Blocks) should reach here not later than

FRIDAY MORNING.

OFFICIAL NOTICES, PATENT NOTICES, SITUATIONS VACANT, SITUATIONS WANTED, PARTNERSHIPS, AGENCIES, ARTICLES FOR SALE, ARTICLES WANTED, ETC.

Latest Time 5 p.m. WEDNESDAY.

The ELECTRICAL REVIEW is the recognised Medium of the Electrical Trades, and has BY FAR THE LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

ELECTRICAL

PARTNERS and PARTNERSHIPS

can be obtained through

WHEATLEY KIRK, PRICE & CO.

(Established 1850).

46, Watling Street, London, E.C. 4.

16, Albert Square, Manchester. **26, Collingwood Street, Newcastle-on-Tyne.**

G. R.

BY DIRECTION OF THE DISPOSAL BOARD.

HIGHLY IMPORTANT SALE BY AUCTION OF THE

Valuable Buildings with the Interior Fittings,

AT BICESTER AERODROME, OXFORDSHIRE

(within two miles of L. & N.W.R. and G.W.R. Main Line Stations).

On THURSDAY & FRIDAY, JANUARY 12th & 13th,

Commencing at 11 o'clock each day precisely.

COMPRISING two large Double Aeroplane Sheds, 170 ft. by 200 ft. by 25 ft., built in hollow terra cotta slabs with brick piers and timber roofs, covered with asbestos sheeting on each side of the large glazed skylights, each fitted with doors, windows, &c. One A.R.S. Shed of similar design, 170 ft. by 100 ft. by 25 ft. Technical Store, 120 ft. by 30 ft. by 10 ft., built in 4½ in. brickwork with piers. Sixty other buildings built in brick and breeze slabs of various dimensions, including the large Regimental Institute, Barrack Blocks, Bath Houses, Pig Styes, &c. Heavy iron 4 in. Water Main. The large Iron Water Tank, approx. 32 ft. by 28 ft. by 8 ft., as fixed on steel joists. Two 70-h.p. Vertical Oil Engines, by Robey. Two open-type prot. Dynamos, Main Switch Boards, &c. The fittings include a large quantity of roll-top Baths, white eathenware Lavatory Basins, Sinks, Flushing Cisterns, W.C.'s, and a number of miscellaneous effects.

Further particulars and full descriptive catalogues may be obtained from the auctioneers, Messrs.

BUCKELL, BALLARD & PENNINGTON,

8, Cornmarket Street, Oxford. Nat. Tel. 122. And at Market Square, Bicester; Tel. 11. 8123

To Electricians, Contractors, Factors, &c.

THE MART.

119/121, NEWINGTON CAUSEWAY, LONDON, S.E.1.

The ASSETS AUCTIONS CO., LTD.,

are instructed to SELL BY AUCTION, WITHOUT RESERVE,

On THURSDAY, JANUARY 5th, at 12.30 prompt,

18,500 VARIOUS WOOD BLOCKS, Electric Ships' Logs, Blowers, Drillers, Radiators, Toasters, Footwarmer, Sterilizer, Gyrometer, Recording Voltmeters, Meters, Fans, SUCTION CLEANER, Fuse and Switchboards, Conduit Fittings and Tubing, PLATING VAT, IRONCLAD SWITCHES up to 300 v., Panels, 500 and 300 Watt Lamps, Tape, Telephones, various Cable, Magnetos, Outside Lamps, ALABASTER, SILK, &c., BOWL FITTINGS, Fuse Wire, 5,000 Galvanised Telephone Brackets, Electric Shades, Holders, Switches, Reflectors, Roses, Morse Tappers and Lamps, Striplite, ½, ¾ and 2-h.p. Motors, various voltages, &c.

On view day previous and morning of sale. Catalogues upon application. 'Phone: Hop 3862. 8144

G. R.

BY DIRECTION OF THE DISPOSAL BOARD.

SALE BY AUCTION IN LOTS

of

PLANT, MACHINERY, ELECTRICAL EQUIPMENT, OFFICE FURNITURE, &c.,

At C.S. DEPOT 1208, QUEEN'S DRIVE, WALTON, LIVERPOOL,

C.S. DEPOT 40, BIRKENHEAD,

EAST AND WEST FLOAT DOCK ROAD, BIRKENHEAD,

H.M. FACTORY, ELLESMERE PORT, CHESHIRE, and at

THE PETROGRAD WAREHOUSE PORT OF MANCHESTER WAREHOUSES, TRAFFORD PARK, MANCHESTER,

On JANUARY 9th and following days, at 11 a.m. precisely each day. Including—

21 HAMMERHEAD Electric Cranes, complete with motors, by Royce. Two four-spindle Gridley Automatics. 30 Roller Dryers, by Bentley & Jackson, Ltd. Six Boiler Storage Tanks, Lancashire Boiler type, 30 ft. x 7 ft. Three M.S. Filters, pressure and vacuum, by Banks, Oldbury. Vertical Steam-driven "Edwards" Air Pump. Two Pressure Gas Producers, capacity 10 tons per 24 hours. Enclosed Steel Coal Elevator. Vertical Steam Engine, 7 in. x 18 in., by Robey. 150-kW. d.c., 250 volts Steam-driven Generating Sets, by J. Howden. Two Duplex Horizontal Air Pumps and Jet Condensers, by Pearn. Five-throw Hydraulic Pump. Hydraulic Accumulator. Hydraulic Intensifier. Six 3,000-h.p. Diesel Engines. Electrically-driven 3-throw Pump, direct coupled to 130 h.p., d.c., 500 volts Electric Motor. Two Electric Hoists, 1 ton. Two 530 h.p. Diesel Engines. Sensitive Drilling Machines. Power Hack Saw. Denbigh Milling Machine. Three Baling Presses. 20 12½-in. Centre Lathes. Single-phase oil-immersed Transformers. 25 Electric Motors, a.c. and d.c., from 5 to 400 h.p., twin cylinder. Dryer Tip Wagons. Rotor Pumps. Thread Milling Machines. Vertical Fabric Testing Machines. Cloth Testing Machine. Acetylene Welding Plant. Motor Regulators. Reducing Sets. Pressure Gauges. Galvanised Iron Fresh Water Tanks. Wireless Material. 30-in. Band Saw, by Haigh & Co., Oldham. Circular Saw Bench, by T. & R. Lees, Manchester. 24 Batteries for Flame Protectors, without Air Bottles and Keys, by Ruston, Proctor & Co., Ltd. Plane Milling Machine, by Kendal & Gent (new). Copper-covered Cable, 11 drums (new). Friction Presses, by Taylor & Challen (new). Four tons Steam Hammer, by B. & S. Massey. Two Switch Panels (new). Generator for Diesel Oil Engine. 16 Receiver Splining Machines, by Pratt & Witney. Six Generating Sets, by Allen, Sons & Co., Ltd. Two Phœnix Motors, and numerous other effects. Office Furniture, consisting of Collapsible Tables, Lined Top Tables, Stationery Cupboards, Card Index Cabinets, 118 Hardwood Chairs, 11 Arm Chairs, 28 Deal Forms, Double Desk, 5 ft. x 5 ft., &c.

Order of Sale: C.S. Depôt 1,208, Walton, January 9th, 1922. C.S. Depôt 40, Birkenhead, January 10th and 11th. H.M. Factory, Ellesmere Port, January 12th. Port of Manchester, Warehouse, Trafford Park, January 13th.

On view January 2nd and following days from 9 till 4 each day.

Admission by Catalogue only, price 1s. each.

For further particulars and catalogues apply to the Auctioneers, MESSRS.

J. HINDLE & SON, F.A.I.,

27, London Street, Southport (Tel. 280), 17a, South Castle Street, Liverpool; and Duke Street, Formby. 8098

HILLIER, PARKER, MAY & ROWDEN,
27, Maddox Street, LONDON, W.

By AUCTION, at the GRAND HOTEL, BROAD ST., BRISTOL, on **THURSDAY, JAN. 12th, 1922**, at 3 o'clock.

FREEHOLD WITH POSSESSION

FACTORY PREMISES,
MIVART STREET, EASTVILLE, BRISTOL.

Ground floor, basement and two upper floors. Frontage to MIVART STREET about 209 ft., and to CATO STREET about 113 ft. Total floor area about 42,000 sq. ft. together with building suitable for garage; large yard and loading dock.

In conjunction with Messrs. ED. T. PARKER & CO., St. Stephen Street, Bristol.
Solicitors; Messrs. Wells & Hind, Fletcher Gate, Nottingham.

Full particulars of the Auctioneers, Messrs.
HILLIER, PARKER, MAY & ROWDEN,
27, Maddox Street, LONDON, W.
Telegrams: "Wunputt, Reg., London." 8132

RADIATOR TUBES, LTD., 11½, Great Dover Street, Borough, S.E.

Metal Plating and Depositing Plant and Radiator Tube Machinery.

Comprising Air Compressors and Receivers, 16 PINE and LEAD-LINED PLATING & DEPOSITING VATS, 38 Tube Rolling Machines, Polishing Heads, Shafting, Pulleys, Belting, Drilling Machines, 3½" Centre Lathe, 5 cwt. Platform Weighing Machine, Laboratory Fittings, one 300-AMP., 4-VOLT GENERATING SET, three 2,000-AMP., 6-VOLT PLATING DYNAMOS, three 20-H.P. SLOW-SPEED ELECTRIC MOTORS, eight ELECTRIC MOTORS, D.C. 460 VOLTS VERTICAL BOILER, ACID-RESISTING PUMPS, &c. Also OFFICE FURNITURE, including: Safe by Cooper, Remington and Monarch Typewriters, Mahogany and other Writing Tables and other Miscellaneous Items.

LEOPOLD FARMER & SONS

will SELL the above by AUCTION early in JANUARY, 1922.

Catalogues of the Auctioneers, 46, Gresham Street, Bank, E.C. 2, and Kilburn, N.W. 8140

SITUATIONS VACANT.

Latest Time for receiving, 5 p.m. Wednesday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

ASSOCIATED MUNICIPAL ELECTRICAL ENGINEERS.
(GREAT BRITAIN AND IRELAND.)

BOROUGH OF SWINDON.

APPOINTMENT OF ELECTRICAL AND MECHANICAL ENGINEER.

INTENDING applicants for the above vacancy who are members of this Association are requested not to state a salary less than that provided in the Schedule of Salaries agreed between the Incorporated Municipal Electrical Association and this Association, viz., £740 per annum.

(Signed) A. NICHOLS MOORE,
J. E. TAPPER,
Hon. Secretaries.

December 20th, 1921. 8139

SEVENOAKS & DISTRICT ELECTRICITY CO., LTD.

Male Clerk-Typist Wanted.

FOR stock-keeping, costing, and records, and shorthand-typing.

Good opening for young man with some experience, who is energetic and keen, and has capacity for expansion. *Must* be expert shorthand-typist. No "duds" need apply. Salary to commence, about £3 per week, according to qualifications. —Apply, enclosing photograph and references to C. F. Mounsdon, resident engineer and manager, Electricity Works, Sundridge, Nr. Sevenoaks. 8146

SITUATIONS VACANT.—*Continued.*

BRITISH GUIANA.

TELEPHONE Inspector required by the Government of British Guiana for a period of 18 months, with possible permanency. Salary £350 per annum. Free passages. Candidates, age 25 to 35, must be thoroughly conversant with magneto and common battery telephone exchange systems, and subscribers instruments, and have had good experience in overhead cable and pole line construction and maintenance work.

Apply at once, by letter, stating age and experience, and whether married or single, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/10857, and mentioning this paper. 8122

BOROUGH OF HEYWOOD.

Electricity Department.

THE Corporation of Heywood invite applications for the position of Manager of their electricity undertaking. Candidates must have had experience in electricity undertakings, extra-high-tension bulk supply plant, and e.h.t. mains, and have a sound knowledge of the commercial management of electricity supply and distribution (nearly the whole of the supply is received in bulk from a neighbouring local authority) and will be required to take the supervision of the tramways, which are worked by neighbouring authorities under agreement.

Applications, endorsed "Manager," stating salary required, age, and qualifications, accompanied by copies of two recent testimonials, must be received by the undersigned not later than Saturday, January 7th, 1922.

By Order,
GEO. G. BOUCHIER,
Town Clerk.

Town Clerk's Office,
Heywood,
December 23rd, 1921. 8135

ROYAL AIR FORCE.

RECRUITS for the following trades required:—Power Station Engineers, Shift Engineers, Engine Drivers and Dynamo and Switchboard Attendants, for four years' service. Ages:—Ex-Service men, 18 to 38 years; civilians, 18 to 28. Marriage allowance paid to married men of 26 years of age and over.—For particulars, write stating age, or call, Inspector of Recruiting, R.A.F., 4, Henrietta Street, Covent Garden, W.C.2; or R.A.F. Recruiting Depot, 298, Bath Street, Glasgow. 7194

PLUMBER-JOINTER WANTED.

WANTED temporarily, a capable and experienced Plumber-Jointer, accustomed to e.h.t. and l.t. paper-insulated l.c. cables and all-round work.

Standard district schedule rate of wages.

Apply, stating age and experience, with copies of testimonials, to Engineer and Manager, Electricity Offices, Water Street, Colne. 8134

BRITISH GUIANA.

ASSISTANT Telegraph Engineer required by the Government of British Guiana for three years' service in the Posts and Telegraphs Department, with prospect of extension. Salary £450 per annum, rising by annual increments of £25 to £500 per annum, payable locally in dollars at a fixed rate of 4s. 2d. to the dollar. Free passages. Quarters not provided.

Candidates, age 25-35, preferably single, must have had a good technical education, be thoroughly qualified telegraph and telephone engineers, and possess a practical knowledge of wireless telegraphy and telephony.—Apply at once, in writing, giving age and brief details of experience to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/B.G. 11254. 8125

BOROUGH OF NELSON.

THE Nelson Corporation require at once a good Charge Engineer. Applicants must be possessed of sound technical and mechanical knowledge, and thoroughly experienced in modern power station practice, e.h.t. 3-phase rotary converters, and d.c. 3-wire. Preference will be given to one accustomed to Brush Ljungstrom turbos.

Salary in accordance with National Joint Board Schedule.

Applications to be addressed to G. F. Nayler, Electricity Works, Nelson, Lancs. 8130

SITUATIONS VACANT.—*Continued.*

METROPOLITAN BOROUGH OF HACKNEY.

APPOINTMENT OF GENERAL CLERK, ELECTRICITY DEPARTMENT.

THE Borough Council are prepared to receive applications for the above-named appointment, which, under the Council's scale, is a Class 5 position, at a commencing salary of £182 per annum, with two annual increments of £15 expedited in order to bring the salary up to not less than £4 per week.

The maximum salary of the class is £260 per annum.

The salary will be payable monthly, and be subject to review as the Board of Trade index figure of the cost of living falls below 100 per cent. above pre-war level. The salary is also subject to a percentage deduction in accordance with the provisions of the Council's Superannuation Act, 1908.

Applicants for the position must have reached the age of 21 years, and have had previous experience in an electricity undertaking or upon analogous work with a manufacturing or contracting firm; be quick and accurate at figures (including elementary mathematics); and possess a knowledge of the preparation of wages. Experience in shorthand and typewriting will be considered an advantage.

The appointment will be held during the pleasure of the Council, subject to one month's notice on either side.

The person appointed will be required to pass satisfactorily a medical examination within 14 days of appointment, and before entering upon the duties.

Applications must be made on printed forms, to be obtained from the undersigned on receipt of a stamped addressed (foolscap) envelope, and be accompanied by copies of not more than three recent testimonials.

Applications must be endorsed "General Clerk, Electricity Department," and delivered to the undersigned not later than 5 o'clock p.m. on Monday, January 16th, 1922.

Canvassing members of the Council, directly or indirectly, is strictly prohibited, and will be deemed a disqualification.

R. H. R. TEE,
Town Clerk.

Town Hall, Hackney, E.8.
December 23rd, 1921. 8143

CITY OF BRADFORD.

TECHNICAL COLLEGE.

APPLICATIONS are invited for a Lectureship in Electrical Engineering in the College.

A salary up to £550 per annum will be paid to a candidate of suitable qualifications and experience. Candidates must possess a first-class Honours degree or its equivalent, and have special qualifications in high-frequency, high-tension, and thermionic work.

Full particulars of the appointment, and forms of application, may be obtained from the Principal of the College.

Applications to be returned so as to reach me as soon as possible.

N. L. FLEMING, Town Clerk.

Town Hall, Bradford.
December 21st, 1921. 8142

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

DRAUGHTSMAN wanted to take control of tool and plant drawing office. Up-to-date experience of jigs and tools for production of electrical motors and generators of medium and large sizes.—Apply by letter, stating experience, age and salary required, to Metropolitan-Vickers Electrical Co., Ltd., River Don Works, Sheffield. 8118

DRAUGHTSMAN for electric motor control apparatus.—Write full details of experience, age, and salary, Box 1314, Sells, Fleet Street, E.C.4. 4400

ELECTRICAL Fitter wanted, thoroughly qualified and experienced in installation and repairs to motors and generators, a.c. and d.c., up to 250 h.p. Practical experience on manufacture, testing, and repairs of plant essential. Good at bench work.—8128, Electrical Review, 4, Ludgate Hill, London.

FOREMAN wanted by firm of a.c. motor manufacturers, Leeds district. Must be able to do all testing, erecting, &c. Only men who have held similar posts need apply.—State salary, references, 4382, Electrical Review, 4, Ludgate Hill, London.

LONDON Traveller for electric tools and installation work.—State salary required, 8136, Electrical Review, 4, Ludgate Hill, London.

REPRESENTATIVE required (London), by a leading manufacturer of electric incandescent lamps. Salary and expenses only.—All applications, which will be treated in confidence, must state age, experience, and salary required, 8150, Electrical Review, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

SALES Engineer wanted, to follow up tenders for dynamos, motors, &c., d.c. and a.c.; Manchester district.—State fully experience, age and wages expected, 8147, Electrical Review, 4, Ludgate Hill, London.

WANTED for electrical repair works in South Wales, competent Shop Foreman. Must have expert knowledge of a.c. and d.c. windings; also mechanical work. Able to control men.—State experience and salary required, 4374, Electrical Review, 4, Ludgate Hill, London.

WANTED, Experienced Man to repair and test d.c. meters for supply company in London area. Required to read meters at quarter ends and assist with slot meter collection. Hours, 41 per week.—Applicants please give previous experience and wages required, 4406, Electrical Review, 4, Ludgate Hill, London.

SITUATIONS WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

A.A.—Capable Engineer and Commercial Man (34), requires post with supply undertaking, consultants, or commercial engineers. Experienced in power station, transmission (e.h.t.), lighting, power, tramways, drawing office, and administration at home and abroad; also country house and factory plants; good correspondent and draughtsman; fluent Portuguese.—4354, Electrical Review, 4, Ludgate Hill, London.

A CAPABLE Electrician (young and energetic) requires post as Foreman. Experienced in lift erection and wiring for all controls; lighting and power in all its branches; estimating; good organiser; excellent references.—4412, Electrical Review, 4, Ludgate Hill, London.

A GOOD industrious worker seeks Subordinate or Charge position; experienced in lighting, power, private plants, domestic appliances, with electrical machine repairs.—4405, Electrical Review, 4, Ludgate Hill, London.

ADVERTISER seeks situation in any of the following capacities: d.c. dynamo and motor design, assembling, armature and transformer winding, transformer erection.—H., 14, Montague Road, Wimbledon. 4364

ADVERTISER (38), over 20 years' experience public supply undertakings, shift charge engineer, &c., experience with turbines, H.S. steam, gas and Diesel engines, a.c. and d.c. systems, repairs and maintenance, seeks change; country house, works power plant, or public supply.—W., 7, Cambridge Road, Horsham. 4345

ADVERTISER seeks engagement as Supervisor or Foreman Electrician. Thoroughly competent in laying out, supervising, all lighting, telephone, and power installations. Life experience.—4415, Electrical Review, 4, Ludgate Hill, London.

APPARATUS Draughtsman, Chief Electrical, is open for re-engagement at new year. Speciality, design of telephone or kindred apparatus. Sound production experience, including the design of press tools and jigs, &c. Sound technical experience. Honours City and Guilds of London telephony and higher mathematics.—4384, Electrical Review, 4, Ludgate Hill, London.

CABLE Jointer (42), non plumb., seeks situation. 22 years' experience, lead and bitumen mains, services, testing, and meters. Best references.—French, 11, Heron Road, St. Margaret's, Middlesex. 4333

CLERK (30), consumers' accounts, ledgers, meter and unit registers, wages, invoices, wiring accounts. Showroom experience.—4332, Electrical Review, 4, Ludgate Hill, London.

CHARGE Hand; lighting, heating, telephones, motors, plant and battery erection.—W. Bright, 29, Gloucester Road, Cirencester, Glos. 4394

ELECTRIC Welder's Grinder; used to surface welded tram rails.—4315, Electrical Review, 4, Ludgate Hill, London.

ELECTRICAL Fitter wants job on maintenance of factory installation or with contractor. Good estimator and charge hand.—G., 171, Malmesbury Road, Bow, E.3. 4331

ELECTRICAL Engineer (23), A.C.G.I. Three years' technical college (Finsbury), desires start at anything. Experience chief consideration.—4317, Electrical Review, 4, Ludgate Hill, London.

ELECTRICIAN (26), single, would like position on electricity supply; pre-war experience of supply company, knowledge of a.c., d.c. mains, wirings, &c., and conversant with I.E.E. rules and regulations.—4363, Electrical Review, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

ELECTRICIAN, 12 years' experience in installation and maintenance; good mechanic; distance no object; disengaged.—"A.," 74, Westville Road, Shepherd's Bush W.12. 4395

ELECTRICIAN; experienced and reliable; good references. —H. B., A7, Sutton Street, Chelsea. 4403

ENERGETIC man (married), with good connection with motor engineers and contractors, wants position with manufacturers as Traveller, or Indoor Position; quick at figures.—4413, Electrical Review, 4, Ludgate Hill, London.

FIRST-Class Armature Winder (23), requires situation, 8 years' experience (with leading firm), excellent testimonials.—4328, Electrical Review, 4, Ludgate Hill, London.

GENERAL Electrician, experienced in both a.c. and d.c. work. Complete country house lighting.—4389, Electrical Review, 4, Ludgate Hill, London.

JOINTER-Plumber, services or charge outside work. Testing and faults.—4409, Electrical Review, 4, Ludgate Hill, London.

LINESMAN, fully experienced in e.h.t., overhead construction work, desires work at once. Able to erect and take charge; good references.—4373, Electrical Review, 4, Ludgate Hill, London.

WIREMAN, quick, reliable; all systems, accurate estimator; 18 years' experience; disengaged.—4311, Electrical Review, 4, Ludgate Hill, London.

WIREMAN or Charge Hand; good references.—H. Payne, 56, Crowndale Road, St. Pancras. 4386

WIREMAN-Electrician, 23 years' experience, and boy (15) want work, anywhere.—Jones, 32, Ilminster Gardens, Clapham Junction. 4359

WIREMAN, good and quick; power, light and 'phones (prewar), town or country.—Wireman, 23, Chatham Street, Battersea. 4393

WIREMAN (disengaged) wants Job; lighting, motors, casing, barrel.—E., 195, Blackstock Road. 4407

MINISTRY OF LABOUR.

The Proprietors of the ELECTRICAL REVIEW have placed this space at the disposal of the District Director, Ministry of Labour, 3 and 4, Clement's Inn, Strand, W.C. 1, to whom all replies should be addressed, quoting number of advertisement, the date on which it appeared, and the name of this paper.

DRAUGHTSMAN Designer. Age 22, single. Two years' assistant draughtsman, 1 year draughtsman, 2 years chief draughtsman; Royal Air Force 1 year 11 months as draughtsman-designer; electrical engineer student at Regent Street Poly.; good practical law knowledge; good all-round draughtsman-designer, electrical and wireless. (4066/21)

ELECTRICAL Engineer. Age 24, married. Knowledge of French. Experience as railway engineer, supervising, accumulators on charge. Own business general electrical engineer. Inspector and repairing vehicles, batteries. Qualified wireless lecturer. C.D. wire system, e.h.t., 3-phase working, dynamos and motors. (4688/21)

ELECTRICAL Engineer. Major, age 35, single, A.M.I.E.E. Ten years as assistant engineer steam-driven plant; 3-wire, d.c.; 18 months as chief electrical engineer i/c steam-driven plant; 750 kW, 3-phase, a.c., 3,000 volts d.c. plant; substations; rotary converters; overhead transmission; all lighting and power equipment for workshops and camps; thorough knowledge electrical supply work. (98947)

ELECTRICAL Engineer. Captain, age 38, married, A.M.I.E.E.; fully trained in operating side of electric power supply; large modern stations, a.c. and d.c. ;expert knowledge of application of electricity to industrial operation; lighting, power and heating; good commercial experience; control of labour; conversant with American electrical works; good knowledge chemistry. (95004)

ELECTRICAL and Mechanical Engineer. Lieut., age 42, married; A.M.I.E.E. and A.M.I.C.E.; 4 years' apprenticeship loco. works; 8 years' experience erecting engineer i/c of erection of sub-stations for electric underground railways; also i/c of various other plants at gas works; 5 years' resident engineer; 160 h.p. gas engines, 320 h.p. Diesel engine; alternators, switchboard, outside wiring, and h.p. pumps. (3499/21)

ELECTRICAL and Internal Combustion Engineer. Lieut., Age 38, married; 4 years' apprenticeship dynamo and motor construction; 10 years' electrical and general engineering; 3 years at sea in charge of electrical plant; aero engine repair specialist; ground engineer's certificate, Air Ministry; rotary and air-cooled engines. (4923)

ELECTRICAL and Mechanical Engineer. Captain, age 29, single; A.M.I.E.E.; 4 years assistant engineer; experience electrical power supply, distribution, &c.; cable laying l.t., h.t. and h.h.t.; underground cotton and sugar machinery; hydro-electric plant (small). (5657/21)

SITUATIONS WANTED.—*Continued.*

ELECTRICAL Engineer. Age 34, widower. Lieut. German and French; 3 years' apprenticeship; 9 years at St. Pancras Borough Council as charge shift engineer; assistant engineer to Westminister Electrical Supply Corporation; in all, 20 years' experience in running and erection of large plants. (1236/21)

ELECTRICAL Engineer. Age 33, married. 2nd Lieut. A.M.I.C.E., A.M.I.E.E.; fluent French, Portuguese and Danish; 3 years as pupil to Cable Co., going through all shops; 5 years' experience as outside superintendent cables and overhead work; 10 months' experience erection of machinery and construction of works, and starting production of light railway tracks. (97016)

TRAINING Vacancy required in Electrical Engineering. Age 25. C.S.M. Had 12 months' training Sterling Telephone & Elec. Co., and four months' theoretical training Science School, Dublin. Desires to complete. (70503)

FOR SALE.

Advertisements are inserted under this heading at 14s. per inch.

THIS WEEK'S PHŒNIX BARGAINS.

TWO 200-h.p., 500-volt, 220 r.p.m., compound-wound, 2-bearing Motors, £350 each.

Four 350-h.p., 500/550-volt, 575 r.p.m., 3-phase, 50-cycle, slip-ring Motors, £800 each.

Two 60-h.p., 500-volt, 450 r.p.m., enclosed shunt-wound Motors, by Dick, Kerr & Co., £160 each.

Two 35/40-h.p., 500-volt, 50-cycle, 3-phase, slip-ring Motors, by Sandycroft, 1917, £95 each.

One 90-h.p., 500-volt, 50-cycle, 3-phase, 575 r.p.m., slip-ring Motor by Bruce Peebles & Co., £220.

Three 50-h.p., 220-volt, 450 r.p.m., shunt-wound Motors, £160 each.

One 140-kW, 220-volt, Belliss-Westinghouse Steam Set, £800.

Two 200-kW, 220-volt, Allen-Westinghouse Steam Sets, new 1915, £1,100 each.

One 1,000-kW, 6,600-volt, Turbo-Alternator, with Surface Condensing Plant, £3,500.

One 150-kW, 500-volt, Belliss Steam Set, £800.

One 200-kW, 500-volt, Belliss Steam Set, £1,000.

Many other bargains. Now is the time to buy.

The Phœnix Electrical Co., Ltd., 32-36, Broomielaw, Glasgow. 8145

SPECIAL PLANT—UNIQUE OPPORTUNITY.

Excellent Condition.

250-kW CONVERTER.

250-kW La Cour Converter, 6,000/6,600 volts, 50-cycles, 3-phase, to 500 volts d.c., shunt.

500-kW D.C. MOTOR-GENERATOR.

500 kW Crompton Set, practically new, on combined bedplate, 230/240 volts, 460/470, complete with starters for starting either side.

450-kW D.C. STEAM SET.

450 kW Belliss-Crompton, 440 volts, d.c., shunt, 190 lbs. pressure.

100 H.P. D.C. MOTOR.

100 h.p. Mather & Platt, 460 volt, shunt, 390 revs., complete with pulley, rails and starter.

BRITISH CENTRAL ELECTRICAL CO., LTD.,
6 and 8, Rosebery Avenue, E.C.1.

Telegrams: "Briticent, London." 'Phone: Holborn 5848. 8154

FOR SALE.

750-KW Generating Set, Browett, triple Engine, coupled to Lancashire dynamo, 500/550 volts, d.c., 320 r.p.m. 18,000 lb. Surface Condenser and Pumps, by Mirrlees, Watson and Co., all ex Corporation station, and in first-class condition. A bargain. Apply—

R. WALKER, 2, Oswald Street, Glasgow. 9029

FOR SALE.

No.	H.P.	R.P.M.	VOLTS.
1	100	480	110 d.c.
2	55	570	110 d.c.
6	40	520	110 d.c.
5	30	850	110 d.c.
5	24	810	110 d.c.
1	15	940	110 d.c.

All above motors are shunt wound, open protected type, with end shield bearings, complete with open type starting switches, with no-volt release, shunt rheostats, and overload circuit-breakers.—Tweedales & Smalley (1920), Ltd., Castleton, near Manchester. 7971

FOR SALE.—*Continued.*

MOTORS FOR SALE. (Extract.)

COMPLETE LIST SENT UPON REQUEST.

(Comprising Steam, Diesel and Gas Sets, Turbines, Motors, &c.)

New and Second-hand in Good Condition.

A.C. MOTORS, THREE-PHASE.

Ref. No.	Make.	H.P.	Volts.	Cycles.	Revs.	Type.
306	Lahmeyer	450	210	50	230	S.R.
820	Clayton	40	400	50	360	S.C.
808	Westinghouse	60 (2 of)	400	25	480	S.R.
854	Metro.-Vickers	10	400	50	725	S.C.
854	Mather & Platt	10 (2 of)	400	50	725	S.C.
854	Do.	10 (2 of)	400	50	970/725	S.C., bk-geared.
854	Metro.-Vickers	15	400	50	725	S.C.
854	Mather & Platt	20 (2 of)	400	50	725	S.C.
854	Bruce Peebles	20	400	50	725	S.R.
854	Mather & Platt	25 (2 of)	400	50	725/190	S.C., bk-geared.
854	Metro.-Vickers	30	400	50	725	S.C.
854	Do.	40	400	50	725	S.C.
854	Bruce Peebles	40	400	50	725	S.R.
872	Westinghouse	20	440	50	735	S.R.
617	Do.	40 (2 of)	440	50	710	S.C.
1012	Brush Elec.	50	440	40	580	S.R.
210	Westinghouse	50 (6 of)	440	25	475	S.C.
804	Bruce Peebles	207	440	27	314	S.R.
924	Lancs.Dyn'mo	500	440	50	1450	S.R.
917	Crompton	25	500	25	750	S.R.
917	Lancs. Dynamo	90	500	25	725	S.R.
917	Harland	100	500	25	725	S.C.
917	Gr'nw'd,Batley	150	500	25	720	S.R.
840	Mavor & C'lson	300	500	50	750	S.R.
840	Crompton	300	500	50	575	S.R.

D.C. MOTORS.

Ref. No.	Make.	H.P.	Volts.	Revs.	Type.
808	Rees-Roturbo	19	220	1350/1580	S.
656	G.E.C.	25	220	2000	C.
808	Dick, Kerr	40	230	640	S.
808	G.E.C.	40	220	450	S.
1008	B.T.H.	64	220	335	C.
480	Siemens	12½	250	405	C.
910	Westinghouse	50 (2 of)	400	600	S.
910	Mather & Platt	55	400	700	S.
679	G.E.C.	50	440	370	S.
615	Lancs. Dynamo	75	440	1500	C.
915	G.E.C.	50	460	720	—
915	B.T.H.	16	460	490/1350	—
944	Lancs. Dynamo	110	460	650	C.
1021	Mather & Platt	100	460	390	S.
1021	Do.	155	460	380	S.
910	Crompton	100	460/500	500/550	S.
307	Union Electric	85	500	1000	S.
910	G.E.C.	40	500	835	S.
910	Mather & Platt	50	500	275	S.
910	Westinghouse	60 (2 of)	500	600	S.
910	B.T.H.	80	500	600	S.

BRITISH CENTRAL ELECTRICAL CO., LTD.,
6 & 8, Rosebery Avenue, London, E.C. 1. 8155
'Phone.: Holborn 5848. 'Grams: "Briticent, Holborn, London."

THIS WEEK'S BARGAINS.

MOTOR GENERATORS FROM 3 TO 30 kW.

VERY Low Prices.—Glasgow Electrical Engineering Co., Ltd.; 45-47, Pitt Street, Glasgow. Stock list of motors and accessories post free. 7648

MOTORS—REDUCED PRICES.

75-h.p., 3-phase, 415 volts, 50 cycles, 575 r.p.m., slip ring.
25-h.p., 3-phase, 440 volts, 50 cycles, 720 r.p.m., squirrel cage.
40-h.p., d.c., 440 volts, 850 r.p.m.
15-h.p., d.c., 440 volts, 930 r.p.m.
12-h.p., d.c., 440 volts, 300/900 r.p.m., with Brookhirst panel.
5-h.p., d.c., 220 volts, 600 r.p.m., with Brookhirst panel.
7½-h.p., d.c., 220 volts, 750 r.p.m.
5-h.p., d.c., 200 volts, 1,400 r.p.m.
3-h.p., d.c., 230 volts, 1,500 r.p.m., totally enclosed.
2½-h.p., d.c., 220 volts, 1,280 r.p.m. 6254
HIRST, IBBETSON & TAYLOR, 37, Water Street, Manchester.

NEW MOTORS. SPECIAL PRICES.

MAKER'S Guarantee—stock replaced as sold.

SQUIRREL CAGE.	SLIP RING.
1, 2, 3 and 4 h.p. 950 and 1,440 r.p.m.	SINGLE PHASE. 5, 6, 7½, 10 and 15 h.p. 950 and 1,440 r.p.m.
1, 3½, 5, 6, 7½ & 10 h.p. 750 and 1,440 r.p.m.	THREE PHASE. 5, 5½, 7½, 10 and 15 h.p. 750, 950 and 1,440 r.p.m.

Several good S.H. Motors at attractive prices. 6126
ELECTRICAL INSTALLATIONS, LTD., 27, Martin Lane, E.C.4.

FOR SALE.—*Continued.*

THE WELL-KNOWN "CONZ."

Single Phase and D.C. Motors.

IN STOCK. NEW.—With a full guarantee.
And prices are right.

SINGLE PHASE, SQUIRREL CAGE, 50 CYCLES.

¼ h.p, 220 V, 1,500 r.p.m.
1 h.p., 110 V, 1,500 r.p.m.
1 h.p., 220 V, 1,500 r.p.m.
2 h.p., 220 V, 1,500 r.p.m.
2 h.p., 400 V, 1,500 r.p.m.
3 h.p., 400-470 V, 1,500 r.p.m.

SINGLE PHASE, SLIP RING, 50 CYCLES.

3 h.p., 400-470 V, 1,500 r.p.m.
4 h.p., 400-470 V, 1,500 r.p.m.

DIRECT CURRENT.

200 VOLTS.	400-470 VOLTS.
¼ h.p., 1,500 r.p.m.	2 h.p., 1,700 r.p.m.
½ h.p., 1,700 r.p.m.	2 h.p., 1,400 r.p.m.
1 h.p., 1,300 r.p.m.	2½ h.p., 1,700 r.p.m.
1 h.p., 1,500 r.p.m.	3 h.p., 1,600 r.p.m.
1½ h.p., 1,700 r.p.m.	3 h.p., 1,300 r.p.m.
1½ h.p., 1,300 r.p.m.	4 h.p., 1,200 r.p.m.
2 h.p., 1,700 r.p.m.	5½ h.p., 1,500 r.p.m.
2 h.p., 1,400 r.p.m.	7662

THE RENSHAW ENGINEERING WORKS, LTD., Mitcham, Surrey.

500-kW ROTARY CONVERTER, 460-500 VOLTS, D.C.

ONE 500-kW Westinghouse Self-synchronising, 6-ring compound interpole, 50 cycles, complete with transformer; also h.p. and l.p. switchgear, modern machine; condition as new. Immediate delivery. Low price to clear.

One 200-h.p. Motor by Messrs. Vickers, Ltd., 440 volts, 485 r.p.m., compound interpole, open type, with starting gear; new condition.

Three 500-kW Transformers, 10,750/415 volts, 3-phase, 50 cycles.

One 600-kVA Westinghouse Transformer, 6,600/440 volts, three-phase, 50 cycles; brand new.

One 50 kW, oil-cooled Johnson & Phillips Transformer, 400/110 volts, 3-phase, 25 cycles.

Dynamos and Motors, various sizes, 110, 220 and 440 volts, both a.c. and d.c.

MIDLAND COUNTIES ELECTRICAL ENGINEERING CO., LTD.,
136, Sandon Road, Birmingham.
Telegrams: Rheostat, Birmingham. 7979

DYNAMOS.

SIX 3½ kW, 110 volt, compound, 1,430 revs., by G.E.C.; new, with shunt regulators; £28 each. 17 kW, 110 volt, compound, 510 revs., by Holmes, 3-bearing, complete, as new, £115.

Midland Counties Electrical Engineering Co., Ltd.,
136, Sandon Road, Birmingham.
Telegrams: Rheostat, Birmingham. 7980

MOTORS, PETROL-ELECTRIC SETS, DRILLS, &c.

ELECTRIC Klaxons for factory and Fire Hooters, with 200-volt Transformer, £6 10s.

Small Alternators, ¼ kW to 2 kW, 100 to 500 cycles.

Witton-Kramer Motors, 50 periods, 220/240 volts s.p., on small wheeled trolley. Complete with flex. shaft for grinding or drilling, £9.

½-h.p. ventilated a.c. Motors, with 3 in. pulley, £10.

Wilson-Wolf double-ended Electric Grinder, 1 h.p. 220 volt a.c. Motor on heavy pedestal, fitted two emery wheels and twist drill grinder, motor totally enclosed, wheels shrouded.

Rotax d.c. 200/220 volt Motors, ¼ and 1-6 h.p., totally enclosed ball bearings, 4-speed pulley, £5 10s.

Lyon & Wrench Petrol Electric Sets, 1½ kW, 50 volts and 200 volts, £40. Switchboards, £5.

Proof Tape, 1 in. wide, 1s. per lb.

100 amp. D. & S. Distributor Fuse Handles, Tubular Handgrip, 48s. dozen.

Inspection Handlamps, to Admiralty specification. All metal body, with switch and 2-volt accumulator, 6/8 hours' continual light, 25s.

Hand Electric Drills, weight 14 lb., d.c. only, 200/250 volts capacity up to ¼ in. clearance, £7. Bench type, weight 160 lbs. capacity, ½ in. clearance, £15.

7,000 Electric Heating Units, 1¼ amps. and 3 amps. nichrome and mica flat metal clad, 12s. dozen.

Cell-Milking Dynamos, 10 amps., 0/15 volts, £8 10s. Switchboard for ditto, £1 10s.

Mahogany Boxes for 100 volt Dry Batteries, six plug sockets, 2 wander plugs for h.t. wireless or portable testing, 5s.

3 Valve Amplifiers, £5.

Jointless Rubber Gloves, leather palms, 15s. pair.

LESLIE DIXON & CO. (Dept. E.),
9, Colonial Avenue, Minories, E.1. 8099

FOR SALE.—*Continued.*

ELECTRIC MOTORS AT CUT PRICES.

All Machines Guaranteed.

ONLY best makes. Many new, thoroughly overhauled and tested before despatched.

TWO-PHASE, 50 PERIODS, 200 VOLTS (4-WIRE).

One 10 h.p., 1440 r.p.m., squirrel cage.
One 15 h.p., 710 r.p.m., squirrel cage.
One 16 h.p., 715 r.p.m., slip ring.
One 20 h.p., 720 r.p.m., slip ring.
One 40 h.p., 720 r.p.m., slip ring.

THREE-PHASE, 25 PERIODS, 400/440 VOLTS.

Eight 7½ h.p., 1,440 r.p.m., squirrel cage.

THREE-PHASE, 40 PERIODS, 400/440 VOLTS.

One 44 h.p., 760 r.p.m., slip ring.
Two 72 h.p., 760 r.p.m., slip ring.
One 88 h.p., 580 r.p.m., slip ring.

THREE-PHASE, 50 PERIODS, 400/440 VOLTS.

Eighteen 4 h.p., 1,440 r.p.m., squirrel cage.
Thirteen 6 h.p., 1,460 r.p.m., squirrel cage.
Twelve 7½ h.p., 1,440 r.p.m., slip ring.
One 7½ h.p., 1,435 r.p.m., squirrel cage.
Two 60 h.p., 930 r.p.m., slip ring.

We always hold a large stock of machines, both squirrel cage and slip ring, ranging from 1 h.p. to 97 h.p.

One 100 h.p., 480 r.p.m., squirrel cage, 3 bearings.
One 130 h.p., 242 r.p.m., slip ring, 3 bearings.
One 250 h.p., 365 r.p.m., slip ring, 3 bearings.

THREE-PHASE, 50 PERIODS, 500/550 VOLTS.

One 55 h.p., 950 r.p.m., slip ring.
Two 90 h.p., 950 r.p.m., slip ring.
One 110 h.p., 720 r.p.m., slip ring.

THREE-PHASE, 50 PERIODS, 3,000/3,300 VOLTS.

One 300 h.p., 320 r.p.m., slip ring.

DIRECT CURRENT, 220/240 VOLTS.

One 9 h.p., 450 r.p.m., shunt wound.
One 16 h.p., 1,440/1,650 r.p.m., shunt wound.
One 18.3 h.p., 1,450 revs., shunt wound.
One 29 h.p., 620 revs., compound wound, P.V.
One 31 h.p., 780 revs., shunt wound, protected.
One 35 h.p., 300/720 revs., shunt wound, protected.
One 45 h.p., 650 revs., shunt wound, semi-enclosed.
One 45 h.p., 850 revs., shunt wound, totally enclosed.

DIRECT CURRENT, 440/500 VOLTS.

Two 6 h.p., 1,080 revs., shunt wound, E.V., 440 volts.
One 22.5 h.p., 960/1,445 r.p.m., shunt wound, E.V., 440 volts.
One 25 h.p., 800 r.p.m., shunt wound, protected, 440 volts.
One 40 h.p., 200 r.p.m., compound wound, open, 440 volts.
One 60 h.p., 1,080 revs., shunt wound, protected, 500 volts.
One 80 h.p., 200 revs., compound wound, open, 440 volts.
One 250 h.p., 485 r.p.m., compound wound, open, 500 volts.
One 400 h.p., 310 r.p.m., compound wound, open, 500 volts.

CRANE-RATED MOTORS.

Thirteen 220 and 440 volts, series wound, totally enclosed crane-rated motors, 13 to 50 h.p.

Suitable control gear, slide rails and pulleys are always available for the above machines.

MYLAN & SMITH (ENGINEERS), LTD.,

10, East Parade, Sheffield.

Also at 10, Park Row, Nottingham.

'Phone: 760 Central, Sheffield.

'Grams: "Topical," Sheffield.

Electrical Stores: Bamford, Derbyshire, Midland Railway.

7259

FOR SALE.

New Transformers, by B.E.T. Co., Ltd.

THREE-PHASE, 50 CYCLES.

Three 575 kVA, 10,250-11,000/415-440 volts, £550 each.
One 600 kVA, 6,600/440 volts, £575.
Two 1,875 kVA, 6,600/440 volts, £1,300 each.

THE PHŒNIX ELECTRICAL CO., LTD., 32-36, Broomielaw, Glasgow. 7606

THROUGH COMPANY IN LIQUIDATION.

NEARLY New 70-h.p. Motor, by Crompton, No. 109,316; 440 volt, 175 amp., 775 r.p.m., compound wound, continuous current, 14 in. by 14 in. pulley and slide rails, with Patent Ratchet Starter No. 16,233, by Bray, Markham and Reiss, fitted with no-volt and overload release, ammeter, No. 3 double-pole switch box. Price £175.—4996, Electrical Review, 4, Ludgate Hill, London.

FOR SALE.—*Continued.*

ELECTRICAL ACCESSORY BARGAINS.

Still Further Reductions.

SUPERLAMP, Ltd., 111, Great Eastern Street, London, E.C.2., offer the following exceptional bargains:—

Ceiling Roses.
Quality A. 2s. 9d. per dozen.
B. 6s. per dozen.

Switches, 5 amp. tumbler.
Quality A. 8s. 9d. per dozen.
B. 11s. 6d. per dozen.

Lamp Holders.
C.G.S.C., 7s. per dozen.
Batten, 7s. 9d. per dozen.
E.S., 8s. per dozen.
Keyswitch, 17s. 6d. per dozen.

Cut Outs.
5 amp. bow, 6s. per dozen.
5 amp. oblong, 7s. 9d. per dozen.
10 amp. blow, 7s. 6d. per dozen.
10 amp. oblong, 10s. 6d. per dozen.

Counterweight and pulley, 18s. per dozen.

Cable, v.i.r., 600 megohms.
1/18, 10s. 6d. per coil.
3/22, 11s. 6d. per coil.
3/20, 16s. per coil.
7/22, 24s. 6d. per coil.
7/20, 35s. per coil.

Conduit, 5/8 C.J., 7s. per 100 ft.

Black Tape, 2s. per lb.

Wood Blocks, I.W., W.E.
3½ by 1, 1s. 6d.; 1s. 9d. per dozen.
6½ by 3½, 4s.; 5s. per dozen.

Coupled Switches.
5 amp., d.p., unmounted, 2s. 9d. each.
5 amp., d.p., mounted, 3s. 3d. each.
10 amp., d.p., unmounted, 5s. each.
10 amp., d.p., mounted, 6s. each.

Fuseboards Oak Cases.
5-way, 11s. per board.
4-way, 10s. per board.
3-way, 9s. 6d. per board.
2-way, 7s. per board.

Flex, 14/36.
Cotton, 22s. 6d. per gross yards.
Workshop, 25s. 6d. per gross yards.

Wall Plugs (all China), 17s. 6d. per dozen.
Hardwood Base, 22s. 6d. per dozen.

Shades, 10 in. Enam. Iron, 7s. 9d. per dozen.
9 in. Opals, 5s. 6d. per dozen gross lots.

Bell wire, 3s. 6d. per coil.

Electric Lamps.

Drawn Wire, low volt, 1s. 4d. each.
High volt, 1s. 6d. each.
Helical (half-watt pattern), 100 watts, 3s. 3d. each.
60 watts, 2s. 3d. each.
40 watts, 2s. each.

Every lamp guaranteed good and sound. Average tested life over 1,000 hours. We replace faulty or broken lamps. Carriage paid on 24 or more.

Terms subject 5 per cent. discount cash with order. Carriage paid on orders over £12 in value. No samples sent unless cash sent plus cost of carriage. Conduit sent carriage forward. China and glass at buyers risk.

Send for our new January, 1922, price list. Send us your enquiries.

SUPERLAMP, LTD.,

"The Electrical Bargain House,"

111, Great Eastern Street, London, E.C.2.

(Nr. Old Street Tube Station and City Road.)

Telephone: Clerkenwell, 1497. 8115

FOR SALE.—*Continued.*

PETROL AND PARAFFIN ELECTRIC GENERATING SETS.

Guaranteed in First-Class Running Order.

No. in Stock.	Output.	Volts.		Make.
1	500 watts	50	Direct coupled	F. W.
44	1 kW	25/37	Belt	Petters.
4	3·5	50/75	Direct coupled	F. W.
4	4	65	,,	F. W.
1	8	80	,,	Austin.
1	10	100/110	,,	Simplex.
2	10	60	,,	,,
1	10	105	,,	Barlaw.
1	10	220	,,	Aster.
1	10	220	,,	Gardner.
4	12	60	,,	Simplex.
5	12	60	,,	Gardner.
4	14	80	,,	,,
4	16	80	,,	Simplex.
2	18	60	,,	Vickers.
2	21	100/145	,,	Keighley.
2	24	80	,,	Aster.
1	50	220/540 3 phase, 50 cycles.	,,	,,

DYNAMOS.

No. in Stock.	Output.	Volts.		r.p.m.	Make.
6	24 kW	80	Compound	1000	Holmes.
4	3·5	50/75		1300	Lyon & Wrench.
3	4	65	Compound	1400	,,
1	10	110	Shunt	1100	E.C.C.

MOTOR GENERATOR.

One 220/240-volt supply, 11 kW, 50/110-volt, complete with switchgear.

One 440-volt Converter, by Crypto, output 60 volt, 50 amps., 1750 r.p.m., complete with switchgear.

MOTORS.

15 h.p., 440-volt, E.C.C., 645 r.p.m.
20 h.p., 440-volt, Mawdsley, 800 r.p.m.
Both machines complete with slide rails, pulley and starter.

Large Stock of Engines and Dynamos which can be coupled up within seven days.

FYFE, WILSON & CO., LTD.,
31, Budge Row, Cannon Street, E.C. 4.

'Phone: City 2602. 'Grams: "Ductility, Phone, London."
8151

FOR SALE.

DIESEL Engines, six cylinder, two and four stroke, 850, 1,000, 1,200 h.p., excellent condition. Dynamos for above, 250 or 500 volts d.c. Immediate delivery and low price.
Also two 500-kW Parsons Turbine Sets, 250 or 500 volts, d.c., with Condenser and spare armature.
Electrically-driven Air Compressors, 250 volts, d.c., pressures 1,500 to 3,000 lb. per sq. in.

JENNINGS, West Walls, Newcastle-on-Tyne. 6243

INERT BELL CELLS, 1.5 VOLT.

Exceptional Offers.

SURPLUS Government stock (German Reparation), best make, large stocks, well packed in strong cases, each of 100 cells, price 40s. per case; 5-case lots, 37s. 6d. per case, including cases and packing. Carriage forward ex London warehouse. For sample half dozen, post free, send postal order value 4s. Size of cells (exclusive of terminals), 2¼ in. by 2¼ in. by 4¼ in. high.—British & Allied Electrical Agency, Ltd., 13, Charterhouse Street, London, E.C.1. 8126

HIRE OR SALE.

ELECTRIC Motors and Dynamos.—Machines always available. ARMATURES and FIELD COILS rewound or repaired without delay.

'Phone: Museum 8080. MACDONALD, SYER & CO., LTD., 295, Gray's Inn Road, W.C.1. 6246

SURPLUS PLANT FOR SALE IN FRANCE.

LARGE stock of Turbo-Alternators, Diesel and Steam Engines, Transformers, Rotary Converters, Motors and Generators. Very low prices owing to rate of exchange.
Special Bargains:—

Two 1,000-kW British Westinghouse Rotary Converters.
One 940-kVA British Thomson Turbo-Alternator.
One 500-kW British Westinghouse Turbo-Alternator.
One 400-h.p. British Thomson 25-cycle Motor.

ALEX LEFEBVRE, 9, Rue Arséne Houssaye, Paris VIII. 6421

FOR SALE.—*Continued.*

ELECTRICAL PLANT FOR SALE. (Extract.)

(Comprising Steam and Diesel Sets, Turbines, &c.).

COMPLETE LIST SENT UPON REQUEST.

New and Second-Hand, in Good Condition.

DYNAMOS.

Ref. No.	Make.	kW.	Volts	Revs.	Winding.
818	Westinghouse	135	220	300	C.
226	Peebles	495	220	300	S.
315	Holmes	150	450/550	425	S.
441	Elec. Co.	200	480	350	C.
860	Scott, Mountain	150	500	350	C.

ALTERNATORS.

Ref. No.	Make.	kW.	Phases.	Volts.	Revs.	Cycles.
845	Westinghouse	80 (2 of)	3	200	250	50
1004	Hall	95	3	400	750	50
414	G.E.C.	70	3	570	500	25
830	Westinghouse	300	3	3300	375	50

D.C. STEAM SETS.

Ref. No.	Make.	kW.	Volts.	Winding.	Steam lbs.
494	Browett-Jackson	15	100	S.	80
1010	Willans-Peebles	55	110	S.	160
412	Belliss-B.T.H.	50	115	S.	160
830	Browett-Royce	250	210	C.	125
831	Do.	250	210	C.	125
971	Belliss-E.C.C.	100	220	C.	120
971	Do.	200	220	C.	120
1062	Allen-Westinghouse	200	220	S.	160
1062	Do.	375	220	S.	150
998	Willans-Lancs.	350	240	C.	150
74	Belliss-Westinghouse	140	250	C.	130
822	Parker-Mather	100	440	C.	200
830	Mather & Platt	132	440	S.	130
926	Belliss-Crompton	450	440	S.	190
925	Belliss-Dick, Kerr	260	440/550	C.	160
665	Willans-Mather	224	450/550	S.	200
1071	Reavell-G.E.C.	100	460	C.	140
463	Belliss-Siemens	500	460	S.	150
504	Willans-Mather	150 (2 of)	460/500	S.	125
847	Belliss-Crompton	250	460/520	S.	155
309	Belliss-Holmes	180	500	S.	150
236	Willans-E.C.C.	375	500	S.	180

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Ref No.	Make.	kW.	Phases.	Volts.	Cycles.	Steam lbs.
1011	Belliss-Boveri	75	3	250	50	160
1011	Do.	180	3	250	50	160
414	Sisson-G.E.C.	70	3	570	25	100
414	Do.	135	3	570	25	100

A.C. STEAM TURBINES.

Ref. No.	Make.	kW.	Phases.	Volts.	Cycles.	Steam lbs.
452	B.T.H.	125	3	440	50	120
859	Parsons-E.C.C.	500	3	500	50	150
859	Parsons	1000	3	500	50	180
80	Parsons-E.C.C.	300	2	2200	50	170
1044	Westinghouse	1000	3	3300	50	180
645	Willans-Dick, Kerr	2000 (2 of)	3	6600	50	175
852	Willans-W'house	1000	3	11000	40	200

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Ref. No.	kW.	Volts.
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1077	150 (3 of)	220

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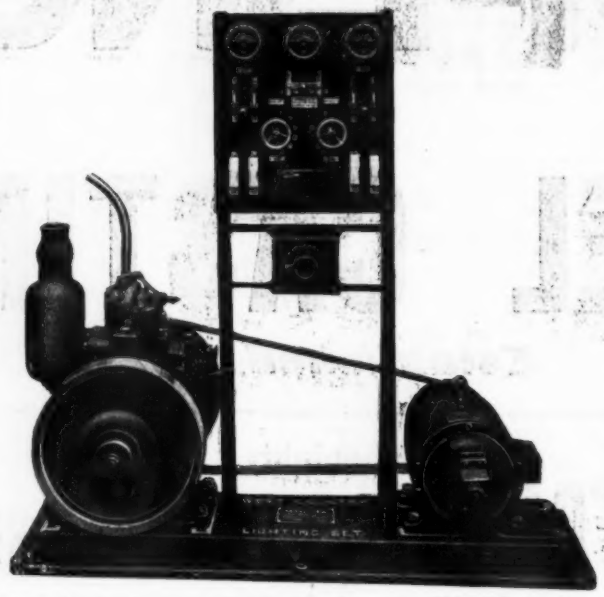

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Important Announcement.

THE Decision of the House of Lords in the important case of the BRITISH THOMSON-HOUSTON CO., LTD., *v.* CORONA LAMP WORKS, LTD., for infringement of Patent No. 10918/1913, covering the

GASFILLED ELECTRIC LAMP

(also known as "Half-Watt Type"),

was pronounced unanimously in favour of the Patent, thereby reversing the judgments given in the Courts below.

This Patent, thus established in favour of the Patentees, was held to cover an invention in incandescent electric lamp manufacture of a high order of merit and the greatest practical utility.

By a mutual interchange of Patent Licenses the ***British Thomson-Houston Co., Ltd., The General Electric Co., Ltd***, and ***Siemens Bros. & Co., Ltd***, manufacture and sell lamps under their respective Trade Marks—***Mazda, Osram,*** and ***Siemens Britannia,*** in accordance with Patent No. 10918/1913, and other Patents. Licenses have been granted to the leading British Lamp Manufacturers, and only Gasfilled Lamps sold under the following Trade Marks are FREE FROM INFRINGEMENT :—

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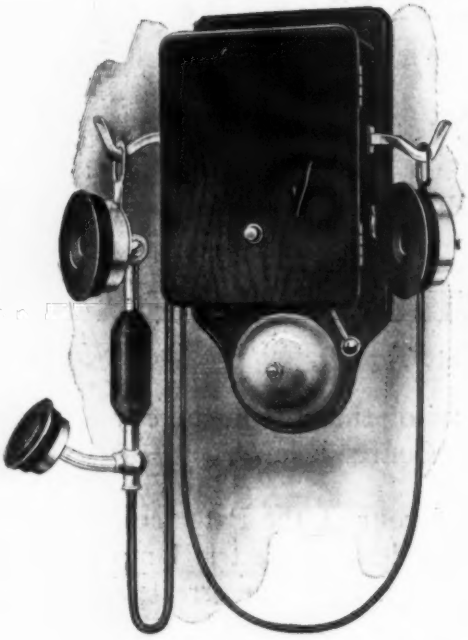

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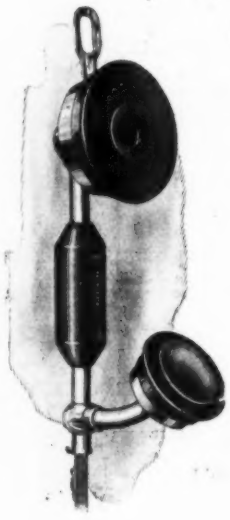

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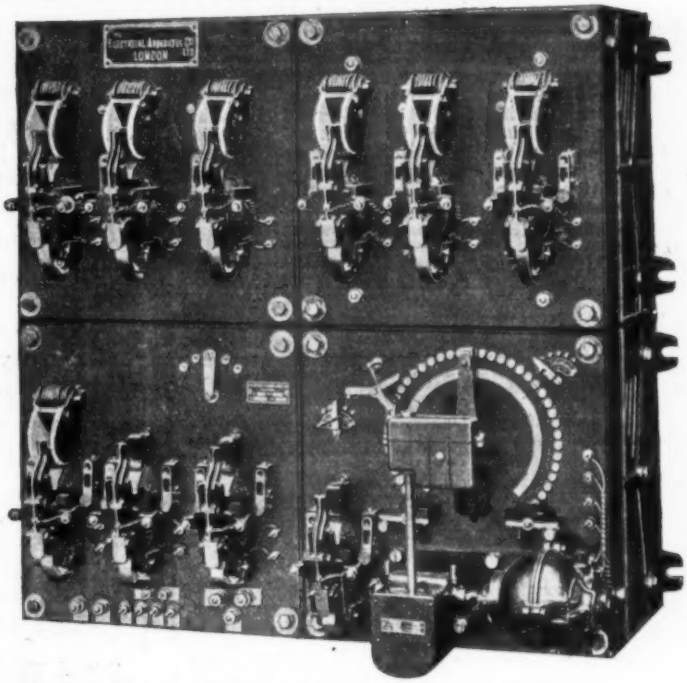

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OFFICIAL NOTICES.

Latest Time for receiving, 5 p.m. Wednesday.

COMMONWEALTH OF AUSTRALIA.

Telephone Apparatus and Parts.

SCHEDULE 544.

THE Commonwealth of Australia invites tenders for above, returnable in Australia by 15th February, 1922.

SCHEDULE V.3.

Thirty tons approx. Wheatstone Tape Paper, White. Tenders invited up to February 14th, 1922, for supply and delivery in Australia. For tender forms and all particulars apply Supply Officer, Australia House, Strand, London, W.C.2. 7928

COUNTY BOROUGH OF EAST HAM.

Extension of Generating Plant.

TENDERS are invited for the supply and delivery of the following:—

EXTENSION No. 4, SECTION "A," CONVERTING PLANT.

One 1,500 kW Converter, either rotary or motor type, for converting 3-phase, 50-period, 6,600 volts, to d.c. 480-500 volts.

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The necessary e.h.t. and low-tension Switchgear and Connections for the above.

Specifications and conditions may be obtained on application to the engineer and manager (Mr. W. C. Ullmann), Nelson Street, East Ham, E.6. Sealed tenders, endorsed "Tenders for Extension of Generating Plant," to be delivered addressed to His Worship the Mayor, Town Hall, East Ham, E.6, not later than 12 o'clock noon of Thursday, January 12th, 1922.

The Corporation do not bind themselves to accept the lowest or any tender.

(By Order).

C. EUSTACE WILSON,
Town Clerk.

Town Hall, East Ham, E.6.
December 16th, 1921. 8109

CITY OF LEEDS.

Electricity Department.

ALTERNATING CURRENT SINGLE-PHASE WATT-METERS.

TENDERS are invited for the supply of Single-phase Watt-meters required during the year ending December 31st, 1922, the minimum number to be called for being 2,000.

Conditions of contract and forms of tender may be obtained from the undersigned.

Tenders are to reach Sir Robert E. Fox, Town Clerk, 26, Great George Street, Leeds, on or before January 12th, 1922, at 10 a.m., in sealed envelopes endorsed "Electricity—Tender for Meters."

The Corporation do not bind themselves to accept the lowest or any of the tenders sent in.

C. NELSON HEFFORD,
Manager.

Electricity Department, 1, Whitehall Road, Leeds.
December 19th, 1921. 8119

In the High Court of Justice. *1921 F. No. 088.*
Chancery Division.
Mr. Justice Russell.

IN THE MATTER OF FULLER'S UNITED ELECTRIC WORKS, LIMITED, AND REDUCED, and

IN THE MATTER OF THE COMPANIES' (CONSOLIDATION) ACT, 1908.

NOTICE is hereby given that a petition presented to the High Court of Justice, Chancery Division, on the sixth day of December, 1921, for confirming the proposed reduction of the capital of the above-named company from £500,000 to £378,794 8s. by cancelling capital which has been lost or is unrepresented by available assets, directed to be heard before Mr. Justice Russell on Tuesday, the 17th day of January, 1922. Any creditor or shareholder desiring to oppose the making of an order for reduction of the capital of the said company under the above Act may appear at the time of hearing in person or by Counsel for that purpose. Such person is required to give two clear days' notice in writing of his intention to appear, with the grounds of his objections, to the undersigned, the solicitors of the company. A copy of the petition will be furnished to any such person requiring the same by the undersigned on payment of the regulated charge for the same.

Dated this 20th day of December, 1921.

CLIFFORD TURNER & HOPTON.
81-7, Gresham Street, E.C.2.
Solicitors for the above-named company. 8121

OFFICIAL NOTICES.—*Continued.*

CORPORATION OF MADRAS.

Electrical Department.

NOTICE.

TENDERS for the supply of the following Electric Cables will be received by the Commissioner, Corporation of Madras, in his office at or before 12 noon on Monday, February 20th, 1922.

Low-Tension Cables.

Forty-two miles of twin 7/.044 S.W.G.
Thirteen miles of twin 7/.064 S.W.G.

paper-insulated, lead-covered and steel tape armoured cables for 225 volt a.c. circuits.

High-Tension Cables.

Two miles of three-core 7/.044 S.W.G.
Five miles of three-core 7/.064 S.W.G.

paper-insulated, lead-covered and steel tape armoured cables for 5,000 volts a.c. circuits with neutral point not earthed.

Printed forms of tender, agreement and specification can be had from the Publisher, "The Electrical Review," 4, Ludgate Hill, London, E.C.4, on payment of 4s. per set, which will not be returned. Only tenders in such forms and complying with the conditions therein will be considered.

C. V. K. CHETTY.
Electrical Engineer.

Ripon Buildings,
Madras, India.
December 1st, 1921. 8149

NOTICES RELATING TO PATENTS.

PATENTS, TRADE MARKS & DESIGNS
IN ALL COUNTRIES.
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Chartered Patent Agent, Consulting Engineer, Enrolled U.S.A. Patent Attorney
Automobile and Electrical Dep.: ROWLAND L. GOOLD
Associate of the Institution of Automobile Engineers, Associate Inst. E.E., C.P.A., F.C.S.
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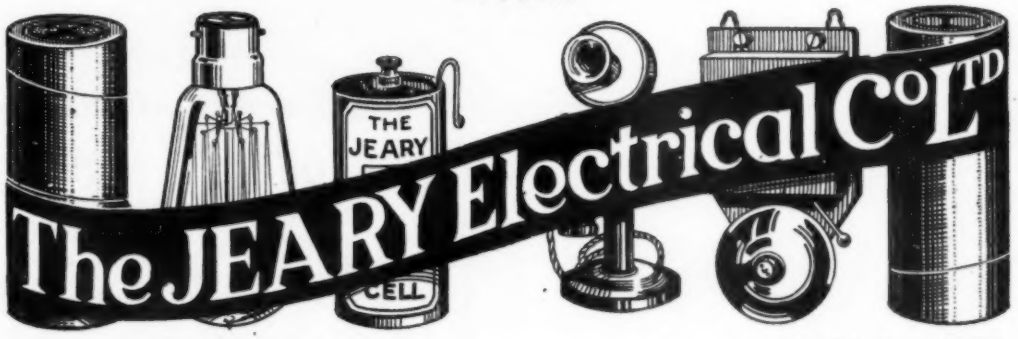

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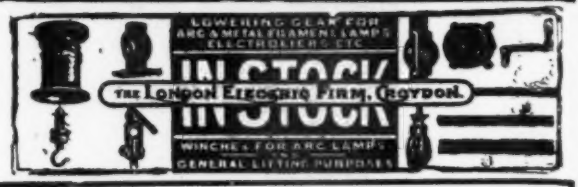
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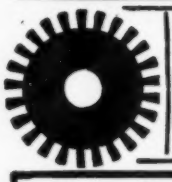
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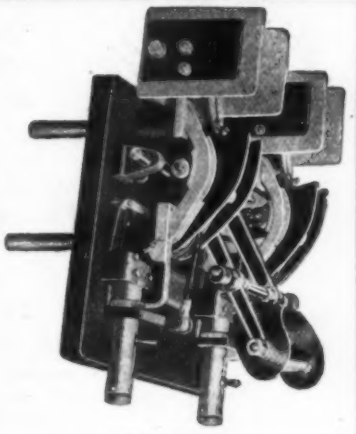

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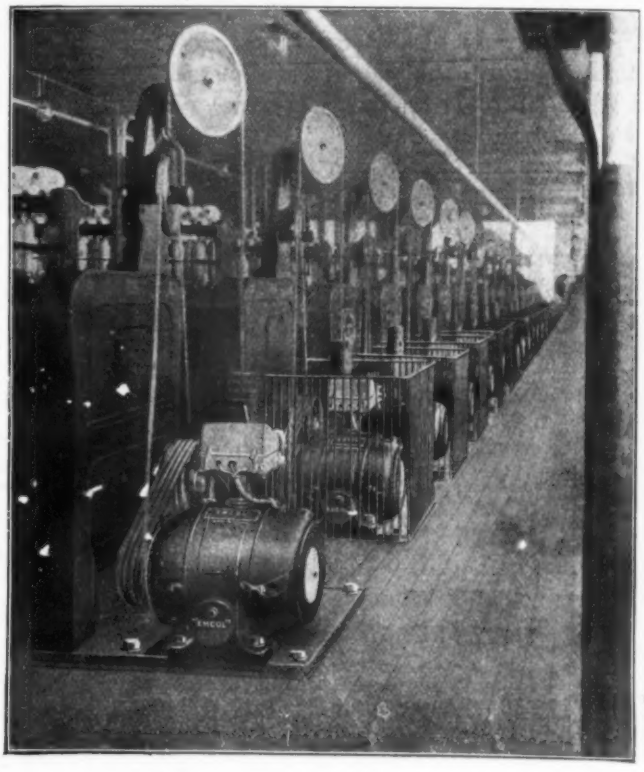

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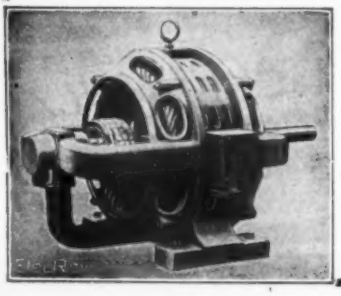
2, CASTLE STREET, ENDELL STREET, LONDON, W.C.2.

Telephone: 1027 Gerrard. Telegrams: "Abeam, London."

BRITISH MADE

POLYPHASE MOTORS.



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We deliver
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IMPULSE STEAM TURBINES,
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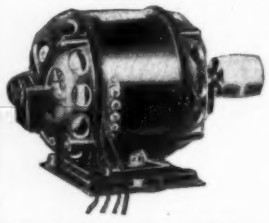
Use a fuse which will really protect those small motors—you can if you install the 1/10 to 1/4 horse power sizes of

Century

REPULSION START—INDUCTION
SINGLE-PHASE MOTORS


Illustrating a ½ H.P. Motor.

Such a protecting fuse will usually be of sufficient capacity to successfully start the ordinary full load.

THEY KEEP-A-RUNNING.

Manufactured only by
CENTURY ELECTRIC COMPANY,
19th Pine to Olive Streets, St. Louis, Mo., U.S.A.

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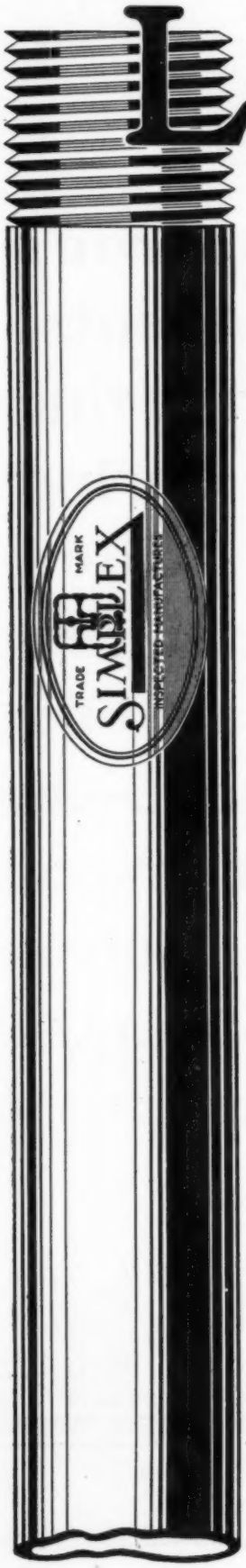

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TRADE MARK
SIMPLEX
INSPECTED MANUFACTURES

WARNING: In numerous instances, imported and inferior grades of conduit are being supplied by certain unscrupulous vendors against requisitions for Simplex conduit. It should, therefore, be noted that the sale of other makes of conduit where "Simplex" is specified is illegal—judgment to this effect having been given in the Courts.

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GUARANTEE: When ordering conduit, therefore, order Simplex conduit and see that every length bears the little red label; it is YOUR GUARANTEE that the conduit supplied is Simplex conduit—conduit that is efficient to the utmost limit of efficiency.

ADVANTAGES: Besides its guaranteeing the source of origin, the label also indicates that the conduit is manufactured from only the highest grade of steel, and that each length is specially inspected and tested for smoothness of bore and accuracy of internal and external diameters. A special process of stoving after enamelling gives the conduit a protective covering of exceptional durability, which is at once elastic and tenacious, and possesses good insulating properties. The threads are well cut AFTER enamelling, and are protected by cardboard caps against damage during delivery.

SOLD THROUGHOUT THE SIMPLEX ORGANISATION

STOCKED AT 14 BRANCHES IN THE U.K. AND OBTAINABLE ALL OVER THE WORLD.

Advt. of Simplex Conduits, Limited, Garrison Lane, Birmingham.

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A Happy and Prosperous New Year to all our Agents! Congratulations on the fine showing you made during 1921, and cordial Good Wishes for still greater successes in 1922! In handling Lalley Light you have—as you know—the best thing of its kind, bar none. Here's wishing you good business in all your departments.

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'Grams: "Studebaker, Wesdo, London."
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Allenwest Drum Controllers are constructed to give uninterrupted service, and there is a design for every requirement.

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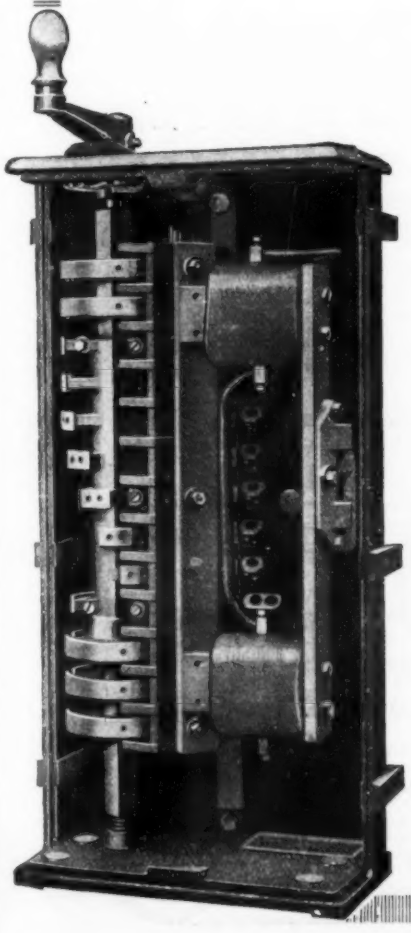

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CONDOR Lamps are still being sold OPENLY and STRAIGHTFORWARDLY and our INDEMNITY is STILL GOOD. Our FRIENDS can rely on us in spite of any statements to the CONTRARY.

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of

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In anticipation of the
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GEORGE ELLISON,

Maker of ELECTRIC CONTROL GEAR,

has decided to

REDUCE SELLING PRICES

10%

This reduction will take effect on
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George Ellison, December 30th, 1921.

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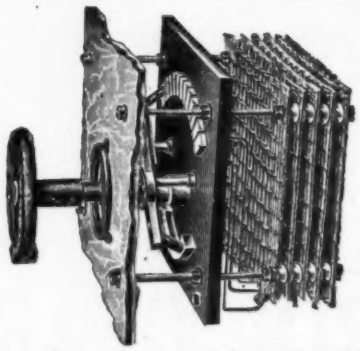
RESISTANCES.



This type of regulator is specially intended for building into switchboards, and is made in any size or capacity.

The main features are
ABSOLUTE RELIABILITY, NEAT AND COMPACT EASILY ACCESSIBLE, EXTREMELY SIMPLE DESIGN, MINIMUM COST OF FIXING, MADE TO SUIT **YOUR OWN EXACT REQUIREMENTS**, AND AT A MODERATE COST.

Pre-eminently suitable for—
Battery Charging Panels, Projection Lamp Switchboards, Shunt Regulation, etc., etc.

We supply these resistances COMPLETE with Hand Wheel and Dial-Plate, all ready for fixing to the switchboard. They can also be supplied with sprocket and chain control.

Please address your enquiries to:—

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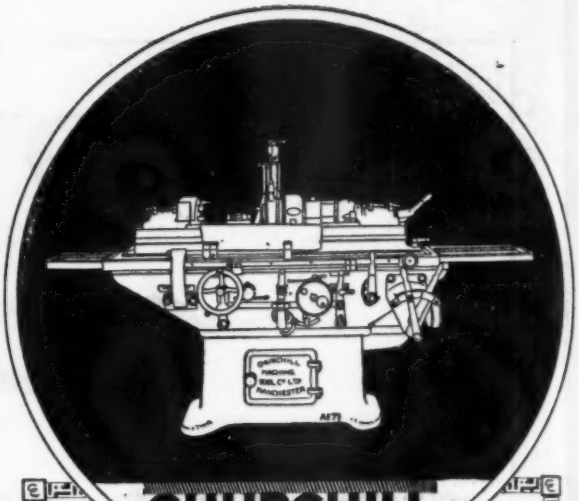

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GRINDERS

You can obtain accurate results very rapidly on Churchill Grinders. This means cheapness in production.
There is no cheaper process for accurately producing finished surfaces, either cylindrical or flat.
The reason Churchill Grinders are so uniformly successful is that they are capable of continuous maximum production.
Whatever grinding work you may have we can give you the right machine.
Tell us what you want. It will cost you nothing and may save you much.

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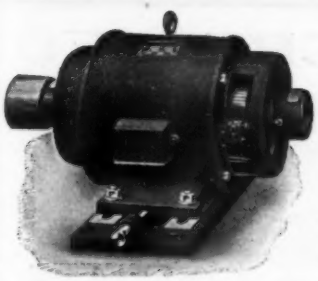

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The SMALL POWER DYNAMO & MOTOR Co., Ltd.,

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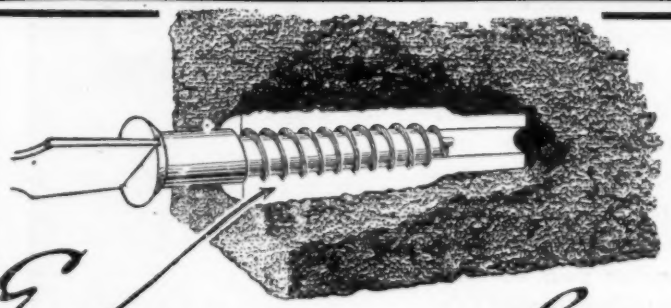


Expansion means Grip!

Look at this illustration and you will see how it is that Rawlplugs provide the only satisfactory method by which screws can be made to hold all kinds of fixtures permanently in any material.

By the old method either you jammed a nail desperately into the plaster, where it worked loose, crumbled the plaster and ruined the wall—or you cut a hole with the cold chisel in the brick beyond, made a wood plug to fit and wedged the plug into position. In either case your fixture was practically bound to work loose and fall sooner or later, because the nail or wood plug merely rested in the wall. It did not grip inside the wall. But Rawlplugs do.

You make a small neat hole with the Rawlplug tool—smaller than the head of the screw—and press the Rawlplug into it. The Rawlplug is a little fibre tube, and when you turn a screw into it, it expands, the screw forms a perfect thread in the Rawlplug, grips the wall like a vice and your fixture becomes part of the wall itself.

Do you Realise all the Possibilities of Rawlplugs?

Whether you drive a nail between the courses or chip the brick away and insert an unsightly wood block, the result after your fixture is up is always the same—trouble and dissatisfaction. With Rawlplugs you simply make a small hole in the brick wherever it is required to fix the screw, insert a Rawlplug, and turn the screw home. A simple, permanent and satisfactory job.

Plaster is always difficult to fix anything to. Nails are useless. Wood plugs break away the face of the wall and make ugly holes which have to be made good by plastering. Only Rawlplugs will hold satisfactorily in plaster. They expand inside the wall with a vice-like grip and become as it were part of the wall.

Wood plugs won't hold in stone. For fixing name plates to outside walls, for lightning conductors, for outside wiring—always use Rawlplugs. There are no maintenance charges with Rawlplugs because once up they never need attention.

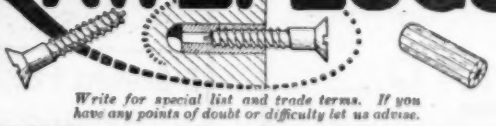
The only satisfactory method of making a fixture with tiles is by means of Rawlplugs, because the tile can be pierced by the Rawlplug Tool without "starring" or damage to the tile and without the necessity of plastering or cementing into position.

Rawlplugs need no skilled handling. They are invisible when in position and cannot damage the walls. Millions have been used in homes all over the country for fixing coat hooks, brackets, and all kinds of fixtures to brick, plaster, tiles, concrete, marble, stone, etc.

Sample Outfit.

Containing 100 Rawlplugs and supply of Screws, special Rawlplug Tool and 2 Bits **5/6**

RAWLPLUGS



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Complete Outfit.

All sizes of Rawlplugs and Tools, Nos. 3-14 **£2**

THE RAWLPLUG COMPANY, LTD., Gloucester House, Cromwell Road, London, S.W. 7.

We Manufacture

1, 2 & 3 PHASE MOTORS

¼ to 35 H.P., Fully Guaranteed.

Slip Ring and Squirrel Cage, with indestructible rotors and very good starting torque.

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COMPETITIVE PRICES

HOWELLS & CO., 105, York St., Hanley, STOKE-ON-TRENT.

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Series "I," 23/- complete.

and, incidentally, your Showroom made more attractive by displaying

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STOCK SIZES: ½", ⅝", ¾", 1", 1¼", 1½", 2".

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DESIGNED FOR FIFTY 20-C.P. LAMPS, AND WORKS TESTED FOR A HUNDRED LAMPS. IT COMPRISES

ENGINE of 2 H.P., giving such complete combustion that exhaust is smokeless and odourless. Its detachable head reduces engine cleaning to a ten-minute job.

CARBURETTOR (automatic) changes from petrol to paraffin without adjustment.

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BATTERY: 27 cells (50 v.) in glass boxes, open top type, 72, 90 or 144 Ah. capacity.

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USE WILLYS LIGHT AND POWER SET WITH ITS LARGE CAPACITY BATTERY, 3-H.P Air Cooled Engine, 1¼ KW. Generator, 225 ampere hours Battery at 22-30 volts.

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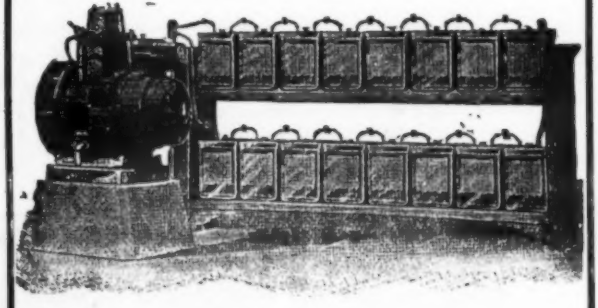
At the reduced price the Willys Light Electric Set is the greatest value for the money ever offered to the Electrical Trade.



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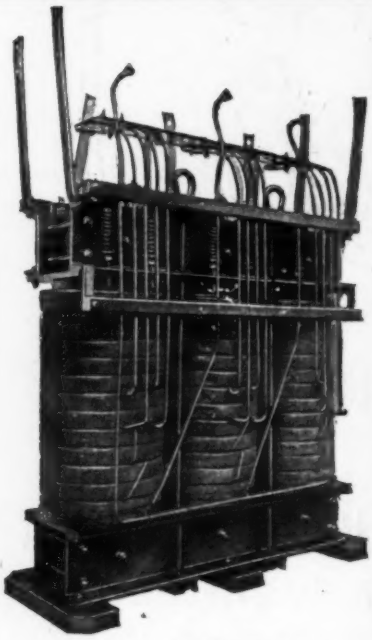

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HAVE 20 YEARS' PRACTICAL A.C. EXPERIENCE EMBODIED IN THEIR DESIGN AND CONSTRUCTION, RESULTING IN A HIGH STANDARD OF RELIABILITY AND EFFICIENCY ATTAINED BY FEW OTHER MAKES.

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BEST FOR EVERY USE.
ACCUMULATOR REPAIRS
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A.E. HARRIS & Co.
FOR ELECTRICAL TRADES
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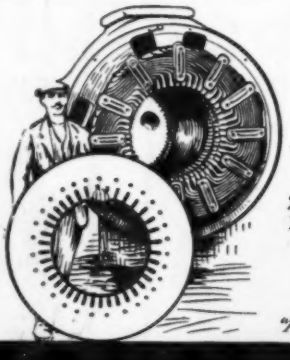
"WESTMINSTER" ARC LAMPS.



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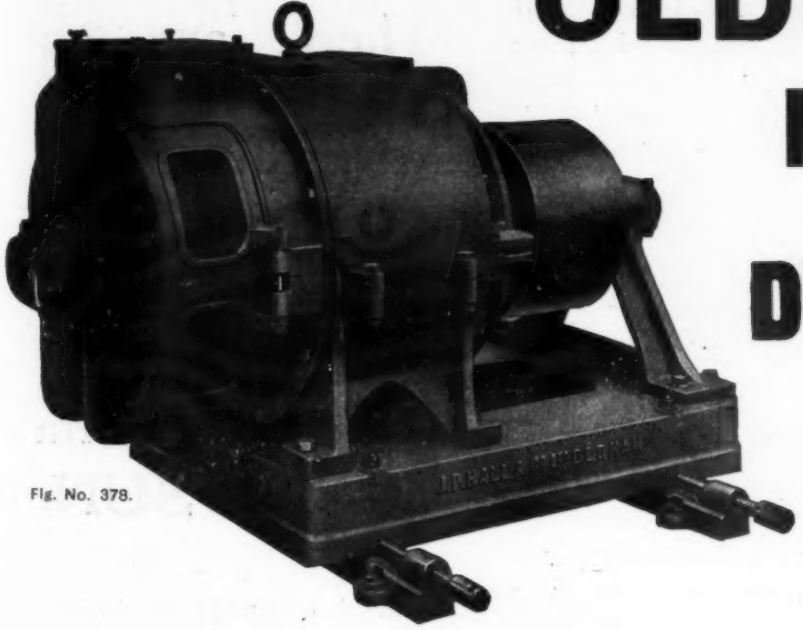

Fig. No. 378.

50-H.P. D.C. MOTOR WITH BEDPLATE AND OUTER BEARING.

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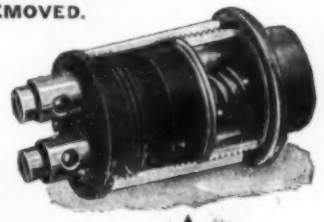

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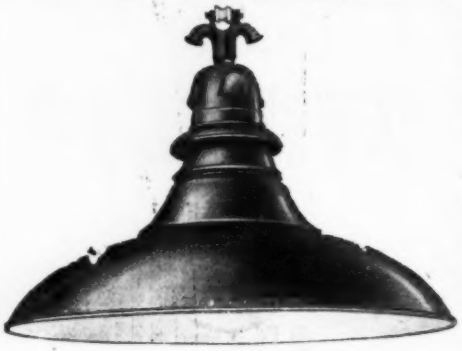

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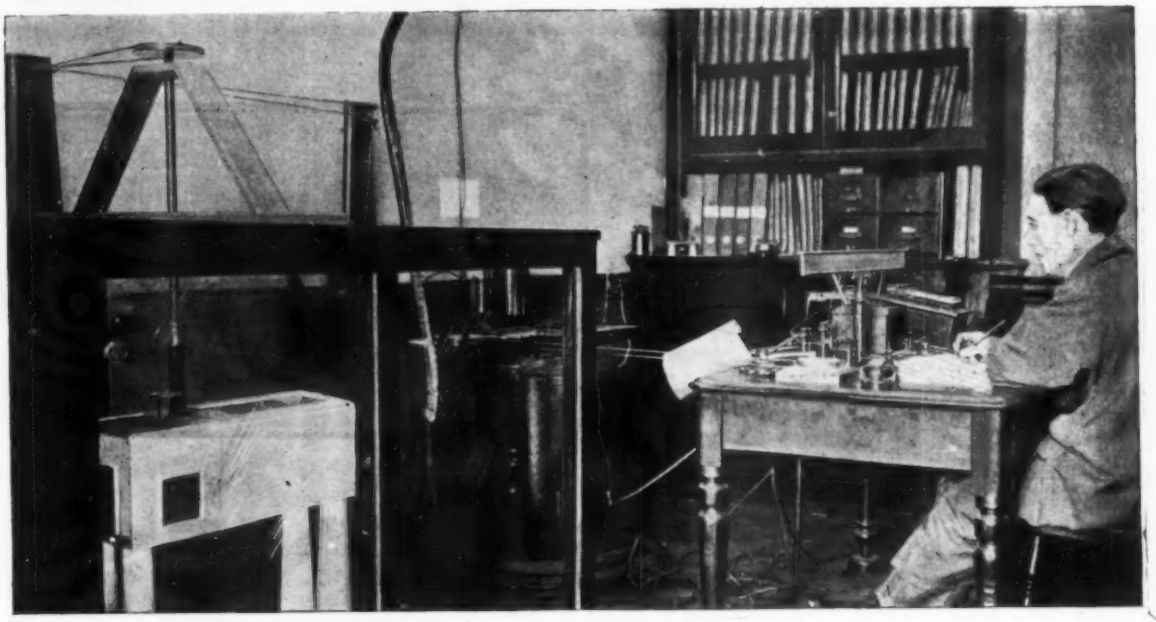

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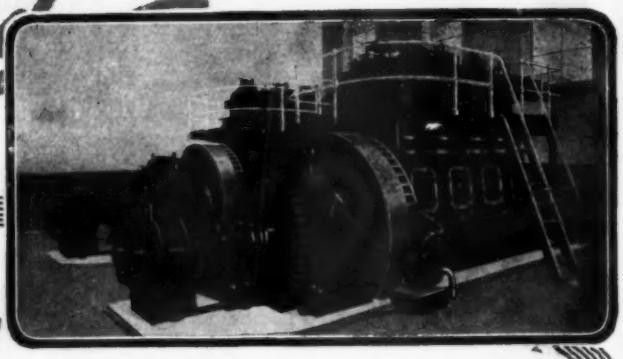

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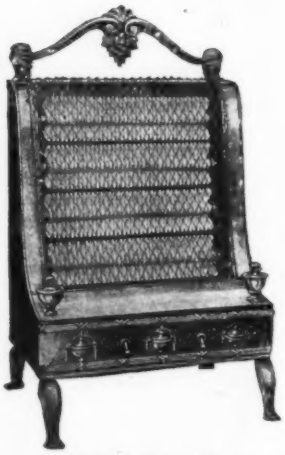

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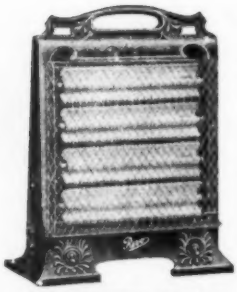

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CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

AYR.—Premises for Dickie, Paterson & Reddick, 92-96, Wallace Street.

BLACKBURN.—Kinema at junction of Bolton Road and Lister Road (£15,000), for T. Fox, Wellington Street (St. John's).

BOWNESS-ON-SOLWAY (WIGTON).—Rectory; the rector.

BURTON-ON-TRENT.—Adaptation of brewery premises as wholesale market; borough surveyor.

CHELMSFORD.—Institute in connection with Baddow Road Congregational Church; Rev. W. H. Pace, pastor.

EXETER.—Business premises, Sidwell Street; J. A. Lucas, architect.

FIFESHIRE.—School at Anstruther (£12,000); clerk, Fife Education Authority, Kirkcaldy.

FOLKESTONE.—Renovation of the baptist church; pastor.

GREENOCK.—120 houses, for Corporation; burgh surveyor.

HAMILTON.—Extension work at hospital, for Town Council (£15,000); burgh surveyor. Alterations to 29, Cadzow Street, for Boots, Ltd., chemists and druggists, Nottingham.

INVERNESS.—Renovation of West Parish Church; the minister. Bacon factory, for the local syndicate; James G. Ramsay, secretary.

LANGLEY (ETON).—Extensions to the Actors' Orphanage; the secretary.

LEEDS.—Alterations to fire-engine house, fire brigade station; W. T. Lancashire, city engineer, Municipal Buildings.

LITTLE WOODCOTE.—School for Surrey E.C.; W. Finney, secretary.

LIVERPOOL.—Kinema, Kensington, for James Leslie Greene, 53, Trinity Road, Bootle.

LLANTRISANT (GLAM.).—Sewage disposal works, for R.D.C.; Thomas and Morgan & Partners, engineers, 23, Gelliwastad Road, Pontypridd.

LONDON (BARNES, S.W.).—Bank, Elm Grove Road and Church Road, for the London Joint City & Midland Bank, Ltd.

(MORTLAKE, S.W.).—Rebuilding the "Jolly Gardeners," for T. G. Lashmar (£7,000 to £8,000); Mr. Humphries, architect.

(WIMBLEDON, S.W.).—Secondary school for girls, for Surrey E.C.; W. W. Finney, secretary (£28,500).

MAGHERAFELT (Co. LONDONDERRY).—Premises and residence, for the Belfast Banking Co.

OLDHAM.—Alterations, "Red Lion Hotel," Bottom-o'-th'-Moor, for Wilson's Brewery (£3,000).

OLD HILL (STAFFS.).—Premises, Plant Street, for Mark Round & Sons, timber merchants.

RAMSGATE.—Conversion of premises, Chatham Street, as boys' secondary school, for Kent E.C.; W. H. Robinson, architect, Sessions House, Maidstone.

RICHMOND-ON-THAMES.—54 houses, for the T.C. Surveyor stores and offices, Water Lane, for the Richmond Lime & Cement Co.

ROCHESTER.—Stores and garage, Charles Street, for West Bros. Alterations, 2 & 4, St. Margaret Street, for S. T. Downs. Machine shop, Blue Bone foundry, for James Hall & Son, Ltd.

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SHEFFIELD.—50 houses, Stubbin Estate, Firth Park; F. E. P. Edwards, city architect, Town Hall.

STAFFORD.—Alterations at "Coach and Horses Inn," Mill Bank, for Eley's Brewery, Ltd.

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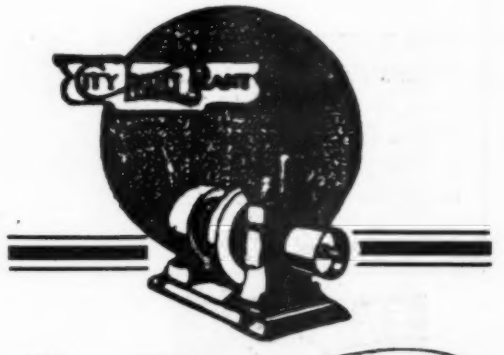

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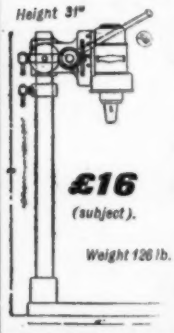

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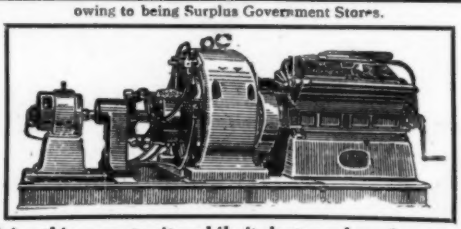

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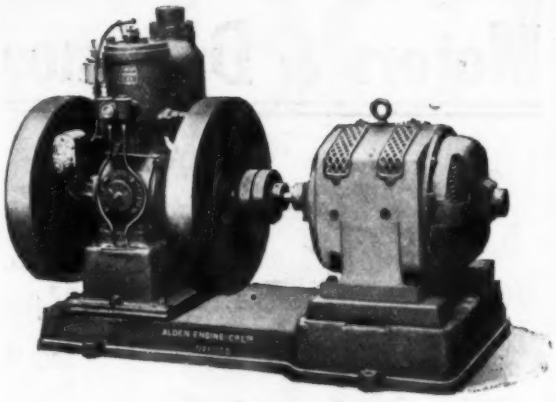

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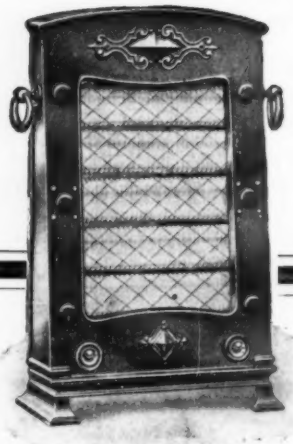

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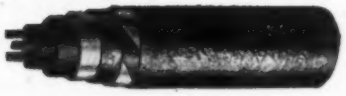

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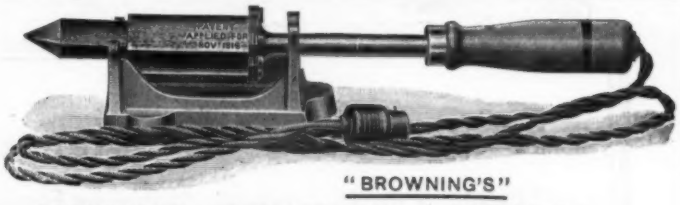

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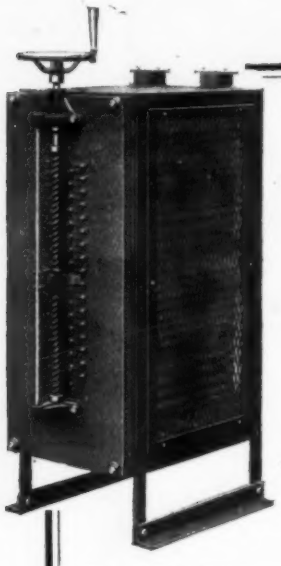

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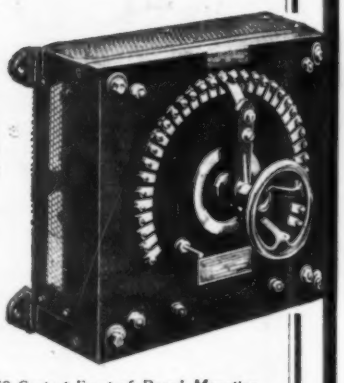

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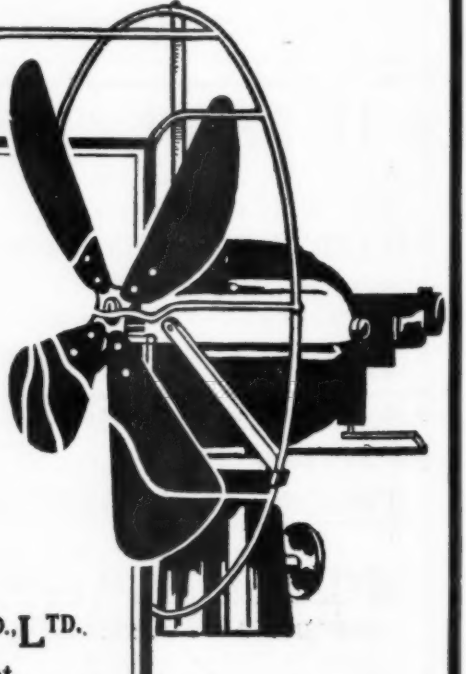

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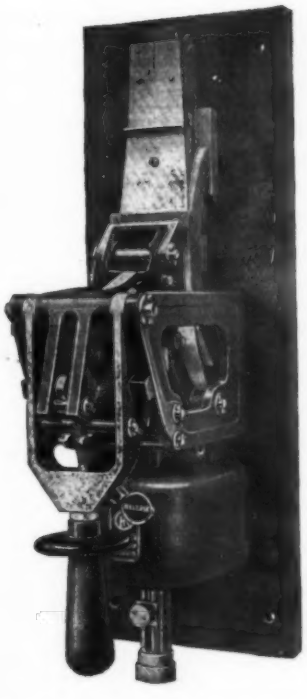

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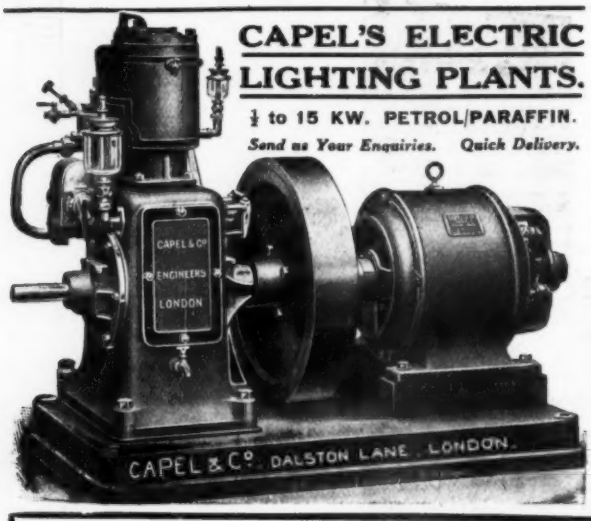

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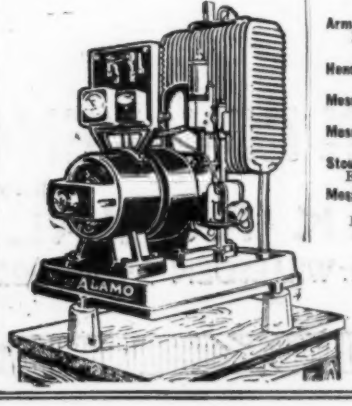

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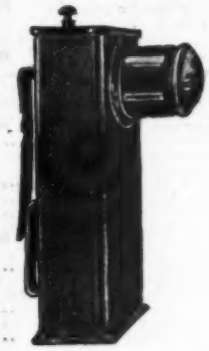

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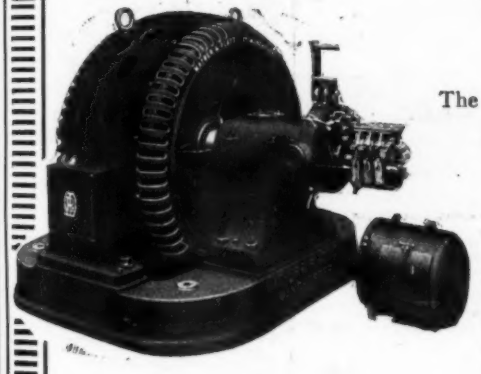

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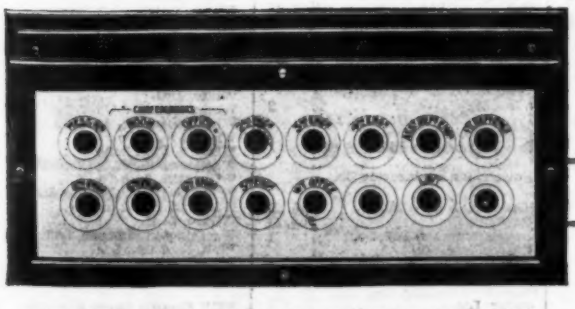

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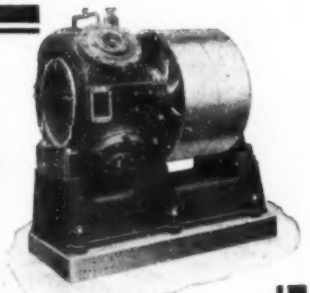

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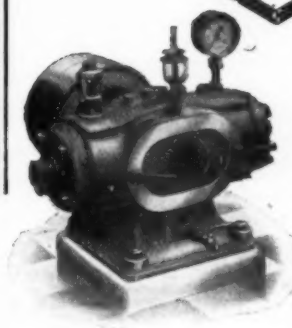

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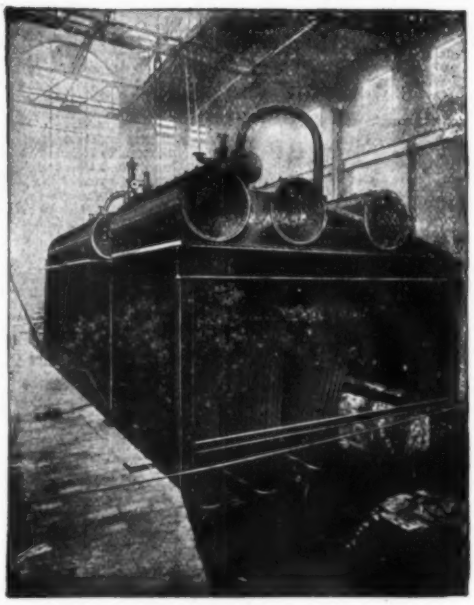

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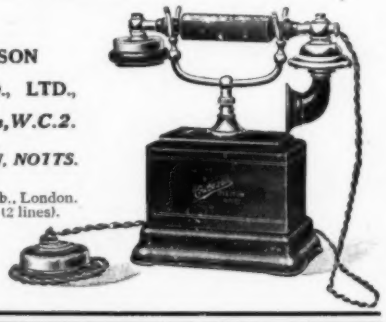

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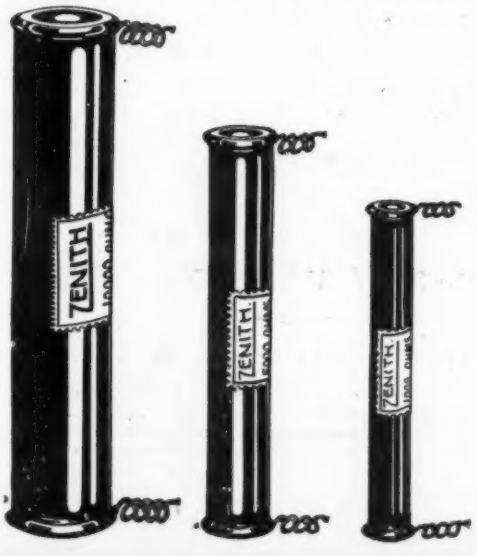

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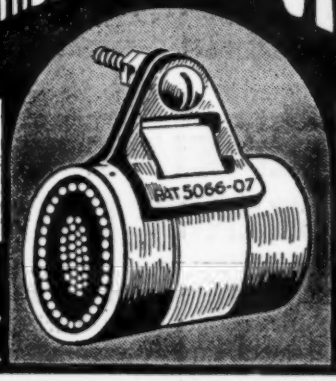

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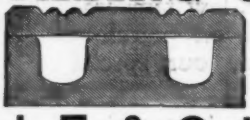

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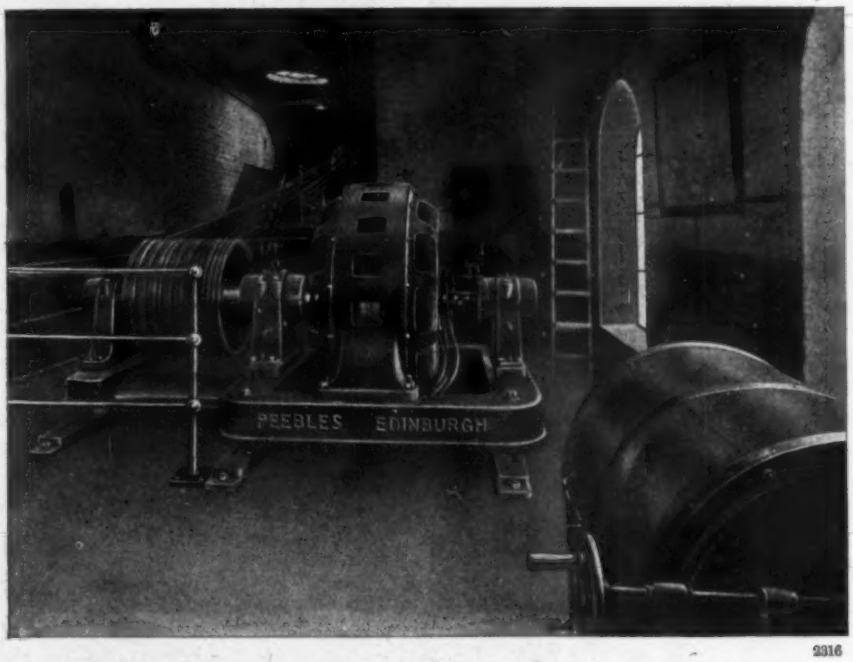

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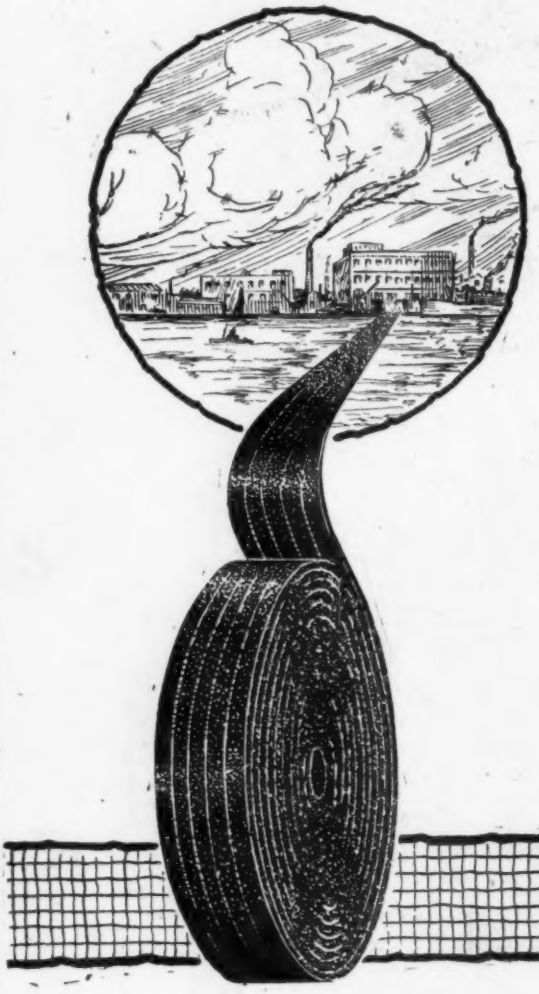

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